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U.S. ENVIRONMENTAL PROTECTION AGENCY

Office of Radiation Programs

INTERNATIONAL NUMERICAL MULTIPLE AND SUBMULTIPLE PREFIXES

Multiples and submultiples	Prefixes	Symbols	Pronunciations
10^{12}	tera	T	tĕr'a
10^{9}	giga	j	j'ga
10^{6}	mega	M	mĕg'a
10^{3}	kilo	k	kĭ'lo
10^{2}	hecto	h	hĕk'to
10	deka	da	dĕk'a
10^{-1}	deci	d	dĕs'i
10^{-2}	centi	c	sĕn'ti
10^{-3}	milli	m	mĭl'i
10^{-6}	micro	μ	mi'kro
10^{-9}	nano	n	năn'o
10^{-12}	pico	p	pē'ko
10^{-15}	femto	f	fĕm'to
10^{-18}	atto	a	ăt'to

SYMBOLS, UNITS, AND EQUIVALENTS

Symbol	Unit	Equivalent
Å	angstrom	10^{-10} meter
a	annum, year	
BeV	billion electron volts	GeV
Ci	curie	3.7×10^{10} dps
cm	centimeter(s)	0.394 inch
cpm	counts per minute	
dpm	disintegrations per minute	
dps	disintegrations per second	
eV	electron volt	1.6×10^{-12} ergs
g	gram(s)	
GeV	giga electron volts	1.6×10^{-3} ergs
kg	kilogram(s)	1,000 g = 2.205 lb.
km^2	square kilometer(s)	
kVp	kilovolt peak	
m^3	cubic meter(s)	
mA	milliampere(s)	
mCi/mi^2	millicuries per square mile	0.386 nCi/m^2 (mCi/km^2)
MeV	million (mega) electron volts	1.6×10^{-6} ergs
mg	milligram(s)	
mi^2	square mile(s)	
ml	milliliter(s)	
mm	millimeter(s)	
nCi/m^2	nanocuries per square meter	2.59 mCi/mi^2
pCi	picocurie(s)	10^{-12} curie = 2.22 dpm
R	roentgen	
rad	unit of absorbed radiation dose	100 ergs/g

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RADIATION DATA AND REPORTS

Volume 13, Number 12, December 1972

Radiation Data and Reports, a monthly publication of the Environmental Protection Agency, presents data and reports provided by Federal, State, and foreign governmental agencies, and other cooperating organizations. Pertinent original data and interpretive manuscripts are invited from investigators.

In August 1959, the President directed the Secretary of Health, Education, and Welfare to intensify Departmental activities in the field of radiological health. The Department was assigned responsibility within the Executive Branch for the collation, analysis, and interpretation of data on environmental radiation levels. This responsibility was delegated to the Bureau of Radiological Health, Public Health Service. Pursuant to the Reorganization Plan No. 3 of 1970, effective December 2, 1970, this responsibility was transferred to the Radiation Office of the Environmental Protection Agency which was established by this reorganization.

The Federal agencies listed below appoint their representatives to a Board of Editorial Advisors. Members of the Board advise on general publications policy; secure appropriate data and manuscripts from their agencies; and review those contents which relate to the special functions of their agencies.

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U.S. ENVIRONMENTAL PROTECTION AGENCY

William D. Ruckelshaus, Administrator

Reports

Use of Fallout Cesium-137 as a Tracer to Define the Recent Deltaic Facies of a River[1]

Phillip Plato,[2] and Gary C. Goldman[3]

Using fallout cesium-137 as a tracer, the size and location of the deltaic facies in Lake Michigan of the St. Joseph River are described. Approximately 185 sediment samples were collected and analyzed for cesium-137 aboard ship during five working days. Contour lines are shown that represent the measured concentrations of cesium-137 in the deltaic facies produced by the St. Joseph River.

When a river discharges its water into a relatively quiescent body of water such as a lake, a deltaic facies may be formed where suspended matter from the river accumulates on the lake sediments near the mouth of the river. The location and size of the deltaic facies are of concern to investigators interested in the movement of manmade waste products through the aquatic environment. Zinc and chromium from plating plants, mercury from chlorine production plants, pesticides from agricultural lands, and many other waste products can enter a river. These pollutants may build up to relatively high concentrations in the deltaic facies produced by a river.

The study of the accumulation of any pollutant in sediment generally involves the collection of large numbers of grab samples of bottom sediment over a predetermined sampling grid. These samples are usually transported to a land-based laboratory where the pollutant to be studied is extracted and measured by an appropriate analytical technique. Since the cost of extraction and analysis is high, only a limited number of samples can usually be processed. Thus, an area of particular interest may be missed altogether. Furthermore, a long lag time usually exists between the time a sample is collected and the time the analytical results are available for study. If several samples from a particular area are found to contain high concentrations of the pollutant, additional sampling might be required to complete the investigation.

This paper describes the procedures and instruments used to determine the size and location of the deltaic facies in Lake Michigan produced by the St. Joseph River (figure 1), using fallout cesium-137 as a tracer. The collection of the sediment samples discussed in this paper and the measurement of these samples for cesium-137 were done aboard the University of Michigan's Research Vessel MYSIS during the summer of 1972. The procedure enabled the investigators to cover a large area of lake bottom in a relatively short period of time with little or no lag time between the collection and analysis of a sample.

Cesium-137 as a tracer

Cesium-137 is a fission product that has entered the environment for over 20 years as a result of atmospheric tests of nuclear weapons. Estimates from a previous study (*1*) of radioactivity in Lake Michigan indicate approximately 15,000 curies of fallout cesium-137

[1] This work was sponsored by a research grant from the American Electric Power Service Corporation.

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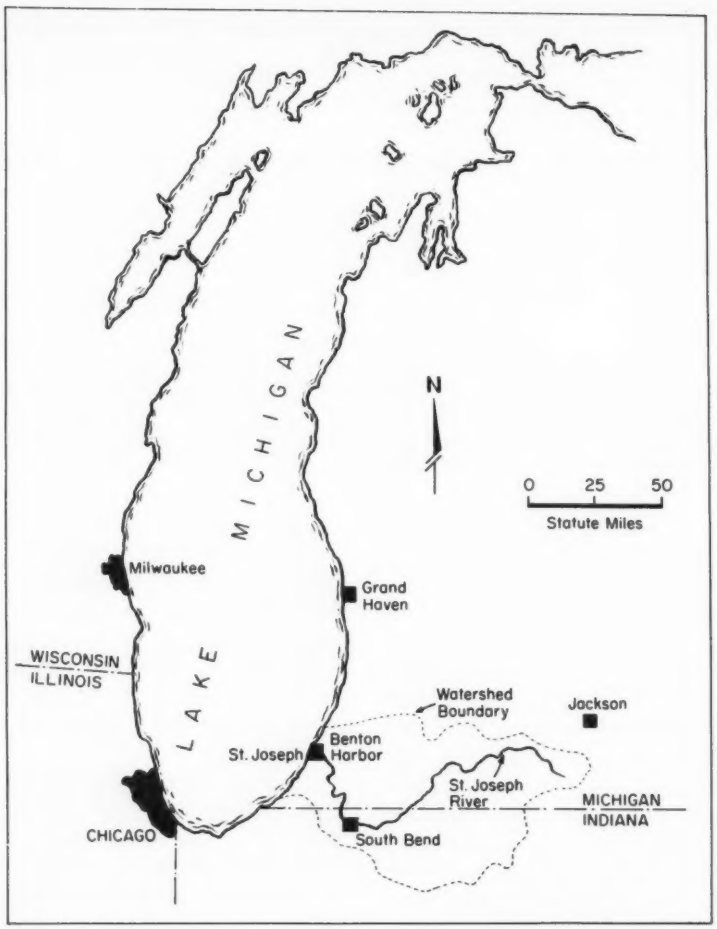

Figure 1. Relative locations of the St. Joseph River and its watershed

entered the Lake Michigan watershed between 1950 and 1970. The watershed of the St. Joseph River is approximately 7 percent (by area) of the entire Lake Michigan watershed (*2*). Thus, about 1,000 curies of fallout cesium-137 have entered the St. Joseph River watershed during the past two decades.

Since the element cesium exists primarily in the ionic form, it is reasonable to expect that the isotope cesium-137 remains in the ionic form unless it becomes attached to suspended matter. Kantsky (*3*) found that approximately 10 percent of the cesium-137 in samples of river water was associated with suspended solids while 90 percent remained in the ionic form. Thus, perhaps as much as 100 curies of cesium-137 have been discharged by the St. Joseph River into Lake Michigan attached to suspended solids. Most of these suspended solids subsequently settled to the bottom of the

lake. An examination of bottom sediments near the mouth of the St. Joseph River for high accumulations of fallout cesium-137 should indicate areas where the sedimentation rate is the highest.

Several properties make cesium-137 an attractive radionuclide to use as a tracer in the environment. It is among the most abundant fission products produced in the detonation of a nuclear weapon. It has a relatively long half-life of 30 years. It decays by the emission of a gamma ray of high abundance and high energy (85 percent of the decays of cesium-137 result in a gamma ray with an energy of 0.66 MeV). The high abundance and energy of the gamma ray permit a sample of sediment to be measured quantitatively for cesium-137 without extracting the cesium-137 from the sample.

Procedure

Two samples of sediment were collected with a small dredge at each sampling station. The dredge collected a block of sediment with a surface of approximately 23 cm by 23 cm to a depth of about 8 cm. The top 3 cm were removed as carefully as possible from each block of sediment and placed in a plastic bag. The two bags of sediment from each sampling station were placed in an annular configuration around a 7.5 cm diameter by 7.5 cm thick sodium iodide detector to give a reproducible counting geometry. The sodium iodide detector was coupled to a 200-channel pulse height analyzer.

The two bags of sediment collected at each sampling station were counted as one sample for 200 seconds. The pulse height spectrum that was produced by each sample was displayed on an oscilloscope, and the height of the cesium-137 photopeak above background was recorded as a measure of the relative concentration of cesium-137 in the sample.

Results and discussion

Figure 2 shows the locations of the sampling stations and contour lines that represent the measured concentrations of cesium-137 in the sediments of Lake Michigan near the mouth of the St. Joseph River. Approximately 185 samples were collected and analyzed for cesium-137 during five working days aboard ship.

Little or no accumulation of cesium-137 appears to occur within about 8 km of shore. The effect of wave action and turbulence on the bottom is greatest within this area and is probably the main reason why suspended matter from the river does not accumulate near shore.

The predominant water movement near the mouth of the St. Joseph River is toward the north (*4*). Thus, cesium-137 carried into the lake on suspended matter from the river is expected to be distributed over a larger area of the lake bottom north of the river mouth than south. Data shown in figure 2 tend to support this prediction.

The topography of the lake bottom in the area shown in figure 2 bears little resemblance to the measured accumulation patterns of fallout cesium-137. The lake gradually becomes deeper (almost linearly) as the distance from shore increases. Depths of 100 m are encountered beyond 35 km from shore.

The sediment samples collected are currently being analyzed for cesium-137 in the laboratory in the conventional manner (i.e., oven-dried, weighed, and counted) to determine if the field method of analysis is adequate to define areas of relatively high and low concentrations of cesium-137 in sediment. Trace-element measurements will be performed on several samples found to contain very high and very low concentrations of fallout cesium-137 to determine if a correlation exists between relative concentrations of cesium-137 and other manmade pollutants.

A study is in progress (*5*) designed to compare the fallout cesium-137 discharged by the St. Joseph River with the radioactive wastes that will be discharged by two nuclear power plants located on Lake Michigan within 24 km of the river. It is hoped that the accumulation patterns produced by the river (figure 2) can be used to predict the accumulation patterns that will be produced by the nuclear power plants during the next few decades.

Summary

Fifty sediment sampling stations were used

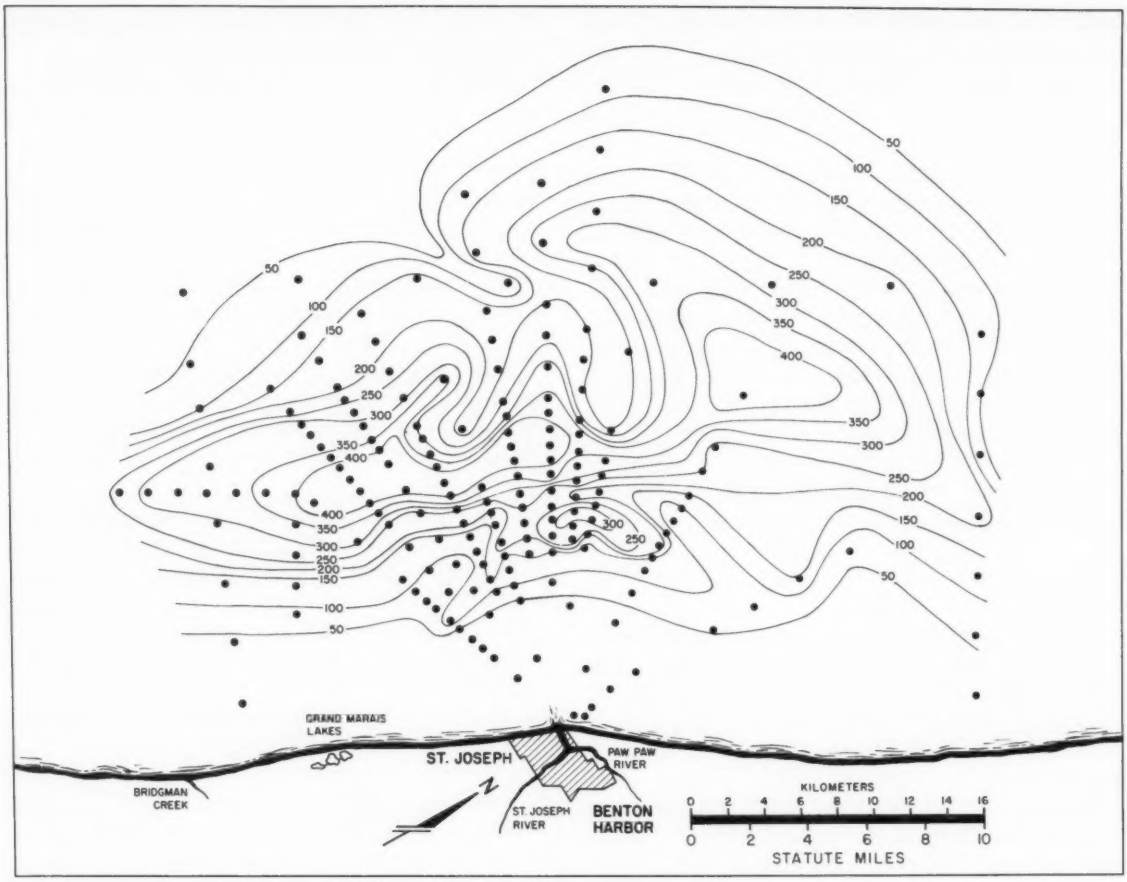

Figure 2. The deltaic facies produced by the St. Joseph River in Lake Michigan (Each dot represents a sediment sampling station. The contour lines represent counts per minute of cesium-137 as measured in the field from gamma ray spectra produced by the various sediment samples)

in a previous study (*1*) to identify general areas of relatively high concentrations of fallout cesium-137 in the sediments of Lake Michigan. These areas of high cesium-137 concentrations were influenced by the total watershed of Lake Michigan. This study involved measurements of fallout cesium-137 made in the field on a relatively large number of sediment samples collected near the mouth of the St. Joseph River, the third largest river that empties into Lake Michigan. The accumulation patterns of fallout cesium-137 shown in figure 2 represent the influence of one river on the sediments of Lake Michigan.

Measurements made in the field on samples of bottom sediment for fallout cesium-137 offer a rapid and inexpensive method to determine the location and size of the deltaic facies pro-

duced by a river. The method enables an investigator to sample a large area of sediment in a relatively short period of time.

The analysis of a sample for cesium-137 can be completed before the ship arrives at the next sampling station. This rapid analysis of a sample permits decisions to be made in the field concerning areas of sediment to be studied in detail.

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SECTION I. MILK AND FOOD

Milk Surveillance, August 1972

Although milk is only one of the sources of dietary intake of environmental radioactivity, it is the food item that is most useful as an indicator of the general population's intake of radionuclide contaminants resulting from environmental releases. Fresh milk is consumed by a large segment of the population and contains several of the biologically important radionuclides that may be released to the environment from nuclear activities. In addition, milk is produced and consumed on a regular basis, is convenient to handle and analyze, and samples representative of general population consumption can be readily obtained. Therefore, milk sampling networks have been found to be an effective mechanism for obtaining information on current radionuclide concentrations and long-term trends. From such information, public health agencies can determine the need for further investigation or corrective public health action.

The Pasteurized Milk Network (PMN) sponsored by the Office of Radiation Programs, Environmental Protection Agency, and the Office of Food Sanitation, Food and Drug Administration, Public Health Service, consists of 63 sampling stations: 61 located in the United States, one in Puerto Rico, and one in the Canal Zone. Many of the State health departments also conduct local milk surveillance programs which provide more comprehensive coverage within the individual State. Data from 15 of these State networks are reported routinely in *Radiation Data and Reports*. Additional networks for the routine surveillance of radioactivity in milk in the Western Hemisphere and their sponsoring organizations are:

Pan American Milk Sampling Program (Pan American Health Organization and U.S. Environmental Protection Agency)—5 sampling stations

Canadian Milk Network (Radiation Protection Division, Canadian Department of National Health and Welfare)—16 sampling stations.

The sampling locations that make up the networks presently reporting in *Radiation Data and Reports* are shown in figure 1. Based on the similar purpose for these sampling activities, the present format integrates the complementary data that are routinely obtained by these several milk networks.

Radionuclide and element coverage

Considerable experience has established that relatively few of the many radionuclides that are formed as a result of nuclear fission become incorporated in milk (*1*). Most of the possible radiocontaminants are eliminated by the selective metabolism of the cow, which restricts gastrointestinal uptake and secretion into the milk. The five fission-product radionuclides which commonly occur in milk are strontium-89, strontium-90, iodine-131, cesium-137, and barium-140. A sixth radionuclide, potassium-40, occurs naturally in 0.0118 percent (*2*) abundance of the element potassium, resulting in a specific activity for potassium-40 of 830 pCi/g total potassium.

Two stable elements which are found in milk, calcium and potassium, have been used as a means for assessing the biological behavior of

HAWAII
LEGEND:
Canadian Sampling Stations
Pasteurized Milk Network Sampling Stations
Pan American Milk Sampling Program Stations
States Presently Reported
0 200 400 600 800 1000 Miles
0 300 600 900 1200 Kilometers

Figure 1. Milk sampling networks in the Western Hemisphere

metabolically similar radionuclides (radiostrontium and radiocesium, respectively). The contents of both calcium and potassium in milk have been measured extensively and are relatively constant. Appropriate values and their variations, expressed in terms of 2 standard deviations (2σ), for these elements are 1.16 ± 0.08 g/liter for calcium and 1.51 ± 0.21 g/liter for potassium. These figures are averages of data from the PMN for May 1963–March 1966 (*3*) and are used for general radiation calculations.

Accuracy of data from various milk networks

In order to combine data from the international, national, and State networks considered in this report, it was first necessary to determine the accuracy with which each laboratory is making its determinations and the agreement of the measurements among the laboratories. The Analytical Quality Control Service of the Office of Radiation Programs conducts periodic studies to assess the accuracy of determinations of radionuclides in milk performed by interested radiochemical laboratories. The generalized procedure for making such a study has been outlined previously (*4*).

The most recent study was conducted during July 1971 with 37 laboratories participating in an experiment on a milk sample containing known concentrations of iodine-131, cesium-137, strontium-89, and strontium-90 (*5*). Of the 17 laboratories producing data for the networks reporting in *Radiation Data and Reports*, 14 participated in the study.

The accuracy results of this study for these 14 laboratories are shown in table 1. Considerable improvement has been made in the accuracy of the analyses of all radionuclides compared to the results of previous studies. Some improvement is still needed in the technique for determining the strontium-90 results. These possible differences should be kept in mind when considering the integration of data from the various networks.

Development of a common reporting basis

Since the various networks collect and analyze samples differently, a complete understanding of several parameters is useful for interpreting the data. Therefore, the various milk surveillance networks that report regularly were surveyed for information on analytical methods, sampling and analysis frequencies, and estimated analytical errors associated with the data.

In general, radiostrontium is collected by an ion-exchange technique and determined by beta-particle counting in low-background detectors, and the gamma-ray emitters (potassium-40, iodine-131, cesium-137, and barium-140) are determined by gamma-ray spectroscopy of whole milk. Each laboratory has its own modifications and refinements of these basic methodologies.

Many networks collect and analyze samples on a monthly basis. Some collect samples more frequently but composite the several samples for one analysis, while others carry out their analyses more often than once a month. Many

Table 1. Distribution of mean results, quality control experiment

Isotope and known concentration	Number of laboratories in each category				Experimental 2σ error (pCi/liter)
	Acceptable[a]	Warning level[b]	Unacceptable[c]	Total	
Iodine-131 (69 pCi/liter)	13 (100%)	0	0	13	6
Cesium-137 (52 pCi/liter)	12 (92%)	1 (8%)	0	13	6
Strontium-89 (31 pCi/liter)	9 (90%)	1 (10%)	0	10	6
Strontium-90 (41.6 pCi/liter)	9 (69%)	1 (8%)	3 (23%)	13	2.4

[a] Measured concentration equal to or within 2σ of the known concentration.
[b] Measured concentration outside 2σ and equal to or within 3σ of the known concentration.
[c] Measured concentration outside 3σ of the known concentration.

networks are analyzing composite samples on a quarterly basis for certain nuclides. The frequency of collection and analysis varies not only among the networks but also at different stations within some of the networks. In addition, the frequency of collection and analysis is a function of current environmental levels. The number of samples analyzed at a particular sampling station under current conditions is reflected in the data presentation. Current levels for strontium-90 and cesium-137 are relatively stable over short periods of time, and sampling frequency is not critical. For the short-lived radionuclides, particularly iodine-131, the frequency of analysis is critical and is generally increased at the first measurement or recognition of a new influx of this radionuclide.

The data in table 2 shows whether raw or pasteurized milk was collected. An analysis (*6*) of raw and pasteurized milk samples collected during January 1964 to June 1966 indicated that for relatively similar milkshed or sampling areas, the differences in concentration of radionuclides in raw and pasteurized milk are not statistically significant (*6*). Particular attention was paid to strontium-90 and cesium-137 in that analysis.

Practical reporting levels were developed by the participating networks, most often based on 2-standard-deviation counting errors or 2-standard-deviation total analytical errors from replicate analyses (*3*). The practical reporting level reflects analytical factors other than statistical radioactivity counting variations and will be used as a practical basis for reporting data.

The following practical reporting levels have been selected for use by all networks whose practical reporting levels were given as equal to or less than the given value.

Radionuclide	Practical reporting level (pCi/liter)
Strontium-89	5
Strontium-90	2
Iodine-131	10
Cesium-137	10
Barium-140	10

Some of the networks gave practical reporting levels greater than those above. In these cases, the larger value is used so that only data considered by the network as meaningful will be presented. The practical reporting levels apply to the handling of individual sample determinations. The treatment of measurements equal to or below these practical reporting levels for calculation purposes, particularly in calculating monthly averages, is discussed in the data presentation.

Analytical error or precision expressed as pCi/liter or percent in a given concentration range has also been reported by the networks (*3*). The precision errors reported for each of the radionuclides fall in the following ranges:

Radionuclide	Analytical errors of precision (2 standard deviations)
Strontium-89	1–5 pCi/liter for levels <50 pCi/liter; 5–10% for levels ≥50 pCi/liter;
Strontium-90	1–2 pCi/liter for levels <20 pCi/liter; 4–10% for levels ≥ 20 pCi/liter;
Iodine-131, Cesium-137, Barium-140	4–10 pCi/liter for levels <100 pCi/liter; 4–10% for levels ≥ 100 pCi/liter.

For iodine-131, cesium-137, and barium-140, there is one exception for those precision error ranges: 25 pCi/liter at levels <100 pCi/liter for Colorado. This is reflected in the practical reporting level for the Colorado milk network.

Federal Radiation Council guidance applicable to milk surveillance

In order to place the U.S. data on radioactivity in milk presented in *Radiation Data and Reports* in perspective, a summary of the guidance provided by the Federal Radiation Council for specific environmental conditions was presented in the December 1970 issue of *Radiological Health Data and Reports.*

Table 2. Concentratons of radionuclides in milk for August 1972 and 12-month period September 1971 through August 1972

Sampling location		Type of sample [a]	Radionuclide concentration (pCi/liter)			
			Strontium-90		Cesium-137	
			Monthly average [b]	12-month average	Monthly average [b]	12-month average
UNITED STATES						
Ala:	Montgomery[c]	P	NA	7	0	8
Alaska:	Palmer[c]	P	NS	5	NS	10
Ariz:	Phoenix[c]	P	NA	0	0	0
Ark:	Little Rock[c]	P	NA	11	0	8
Calif:	Sacramento[c]	P	NA	1	0	0
	San Francisco[c]	P	NA	1	0	0
	Del Norte	P	10	11	0	10
	Fresno	P	0	2	0	5
	Humboldt	P	3	4	0	8
	Los Angeles	P	0	2	0	5
	Mendocino	P	3	5	0	7
	Sacramento	P	2	2	0	5
	San Diego	P	0	1	10	5
	Santa Clara	P	0	1	0	7
	Shasta	P	2	3	10	8
	Sonoma	P	0	2	0	7
Colo:	Denver[c]	P	NA	5	0	4
	East	R	NS		NS	<0
	Northeast	R	NA		<0	<0
	Northwest	R	NA		<0	<0
	South Central	R	NS		NS	
	Southeast	R	NA		<0	<0
	Southwest	R	NA		<0	<0
	West	R	NA		<0	4
Conn:	Hartford[c]	P	NA	6	0	7
	Central	P	8	7	13	13
Del:	Wilmington[c]	P	NA	8	21	7
D.C:	Washington[c]	P	NA	7	11	6
Fla:	Tampa[c]	P	NS	5	NS	41
	Central	R	NA	5	37	42
	North	R	6	9	17	18
	Northeast	R	4	6	36	34
	Southeast	R	5	6	48	58
	Tampa Bay area	P	NA	5	NA	38
	West	R	7	9	14	17
Ga:	Atlanta[c]	P	NA	9	0	12
Hawaii:	Honolulu[c]	P	2	3	0	1
Idaho:	Idaho Falls[c]	P	3	4	0	0
Ill:	Chicago[c]	P	4	6	0	10
Ind:	Indianapolis[c]	P	NA	6	0	3
	Central	P	6	7	0	11
	Northeast	P	7	7	0	12
	Northwest	P	8	8	0	14
	Southeast	P	7	8	0	12
	Southwest	P	7	9	0	12
Iowa:	Des Moines[c]	P	NA	4	0	1
	Iowa City	P	7	7	10	9
	Des Moines	P	5	6	0	9
	Little Cedar	P	5	7	11	12
	Spencer	P	NS	6	NS	10
Kans:	Wichita[c]	P	NA	8	0	1
	Coffeyville	P	6	8	0	11
	Dodge City	P	4	5	0	9
	Falls City, Nebr	R	NS	3	NS	8
	Hays	P	5	9	0	8
	Kansas City	P	5	8	0	11
	Topeka	P	5	7	0	8
	Wichita	P	4	8	0	8
Ky:	Louisville[c]	P	NA	8	0	7
La:	New Orleans[c]	P	15	13	0	8
Maine:	Portland[c]	P	NA	6	21	19
Md:	Baltimore[c]	P	NA	7	0	3
Mass:	Boston[c]	P	7	7	11	10
Mich:	Detroit[c]	P	NA	7	0	8
	Grand Rapids[c]	P	NA	7	0	7
	Bay City	P	4	5	0	11
	Charlevoix	P	5	8	10	12
	Detroit	P	0	5	0	9
	Grand Rapids	P	3	5	0	8
	Lansing	P	5	7	0	11
	Marquette	P	3	6	15	21
	Monroe	P	4	3	0	4
	South Haven	P	5	5	0	8
Minn:	Minneapolis[c]	P	NA	8	22	15
	Bemidji	P	NS	7	NS	18
	Duluth	P	15	16	26	28
	Fergus Falls	P	6	7	13	16
	Little Falls	P	27	18	82	50
	Mankato	P	5	5	9	12
	Minneapolis	P	10	13	13	16

See footnotes at end of table.

Table 2. Concentrations of radionuclides in milk for August 1972 and 12-month period September 1971 through August 1972—continued

Sampling location		Type of sample [a]	Radionuclide concentration (pCi/liter)			
			Strontium-90		Cesium-137	
			Monthly average [b]	12-month average	Monthly average [b]	12-month average
UNITED STATES:—continued						
Minn:	Rochester	P	7	8	11	15
	Marshall	P	3	6	10	10
Miss:	Jackson[c]	P	NA	10	0	8
Mo:	Kansas City[c]	P	NA	7	0	4
	St. Louis[c]	P	NA	7	0	3
Mont:	Helena[c]	P	NA	5	0	4
Nebr:	Omaha[c]	P	NA	5	0	1
Nev:	Las Vegas[c]	P	NA	2	0	0
N.H:	Manchester[c]	P	NA	8	24	17
N.J:	Trenton[c]	P	NA	7	15	5
N. Mex:	Albuquerque[c]	P	NA	2	0	0
N.Y:	Buffalo[c]	P	4	6	0	6
	New York City[c]	P	NA	8	13	8
	Syracuse[c]	P	NA	7	0	6
	Albany	P	6	6	*0	*0
	Buffalo	P	5	5	*0	*0
	Massena	P	9	7	*0	*0
	New York City	P	9	7	*0	0
	Syracuse	P	6	4	NA	0
N.C:	Charlotte[c]	P	NA	10	14	8
N. Dak:	Minot[c]	P	NA	9	0	12
Ohio	Cincinnati[c]	P	NA	7	0	3
	Cleveland[c]	P	NA	6	0	6
Okla:	Oklahoma City[c]	P	NA	6	0	6
Oreg:	Portland[c]	P	5	5	0	5
	Baker	P	(d)		0	0
	Coos Bay	P	(d)		0	3
	Eugene	P	(d)		0	1
	Medford	P	(d)		0	4
	Portland composite	P	(d)		0	6
	Portland local	P	(d)		0	7
	Redmond	P	(d)		0	0
	Tillamook	P	(d)		16	11
Pa:	Philadelphia[c]	P	NA	7	0	3
	Pittsburgh[c]	P	NA	9	0	5
	Dauphin	P	10	7	16	12
	Erie	P	11	7	14	10
	Philadelphia	P	11	5	13	11
	Pittsburgh	P	10	6	11	15
R.I:	Providence[c]	P	NA	6	18	11
S.C:	Charleston[c]	P	9	9	12	14
S. Dak:	Rapid City[c]	P	NA	7	0	4
Tenn:	Chattanooga[c]	P	NA	8	14	9
	Memphis[c]	P	NA	7	0	2
	Chattanooga	P	NA	10	16	13
	Clinton	R	NA	9	10 (2)	13
	Fayetteville	R	NA	9	5 (3)	6
	Kingston	R	NA	9	5 (2)	8
	Knoxville	P	NA	8	0 (2)	8
	Lawrenceburg	R	NS	8	NS	9
	Nashville	P	NA	8	0	6
	Pulaski	R	NA	7	14 (2)	8
	Sequoyah	R	NA	8	24	21
Tex:	Austin[c]	P	NA	3	0	0
	Dallas[c]	P	NA	6	0	0
	Amarillo	R	NA		NA	
	Corpus Christi	R	NA		NA	
	El Paso	R	NA		NA	
	Fort Worth	R	NA		NA	
	Harlingen	R	NA		NA	
	Houston	R	NA		NA	
	Lubbock	R	NA		NA	
	Midland	R	NA		NA	
	San Antonio	R	NA		NA	
	Texarkana	R	NA		NA	
	Uvalde	R	NA		NA	
	Wichita Falls	R	NA		NA	
Utah:	Salt Lake City[c]	P	3	4	0	3
Vt:	Burlington[c]	P	NA	6	11	10
Va:	Norfolk[c]	P	NA	8	0	6
Wash:	Seattle[c]	P	NA	5	0	5
	Spokane[c]	P	NA	5	0	7
	Benton County	R	NS	1	NS	0
	Franklin County	R	0	1	0	2
	Longview	R	4	0	15	
	Sandpoint, Idaho	R	5	11	12	16
	Skagit County	R	8	8	0	5
W. Va:	Charleston[c]	P	NA	8	0	5
Wisc:	Milwaukee[c]	P	NA	5	0	6
Wyo:	Laramie[c]	P	NA	4	0	2

See footnotes at end of table.

Table 2. Concentration of radionuclides in milk for August 1972 and 12-month period September 1971 through August 1972—continued

Sampling location	Type of sample [a]	Radionuclide concentration (pCi/liter)			
		Strontium-90		Cesium-137	
		Monthly average [b]	12-month average	Monthly average [b]	12-month average
CANADA:					
Alberta: Calgary	P	NA		NA	
Edmonton	P	NA		NA	
British Columbia: Vancouver	P	NA		23	24
Manitoba: Winnipeg	P	NA		14	21
New Brunswick: Fredericton	P	NA		NA	
Newfoundland: St. John's	P	NA		41	26
Nova Scotia: Halifax	P	NA		16	20
Ontario: Ottawa	P	NA		10	12
Sault Ste. Marie	P	NA		22	27
Thunder Bay	P	NA		NA	
Toronto	P	NA		6	10
Windsor	P	NA		6	9
Quebec: Montreal	P	NA		6	14
Quebec	P	NA		16	26
Saskatchewan: Regina	P	NA		8	17
Saskatoon	P	NA		11	16
CENTRAL AND SOUTH AMERICA:					
Canal Zone: Cristobal [c]	P	NA	1	0	9
Chile: Santiago	P	0	1	0	1
Colombia: Bogota	P	0	1	0	0
Ecuador: Guayaquil	P	0	0	0	0
Jamaica: Mandeville	P	0	3	35	63
Puerto Rico: San Juan [c]	P	NA	3	0	5
Venezuela: Caracas	P	0	0	0	0
PMN network average [f]		6	6	3	6

[a] P, pasteurized milk
R, raw milk

[b] When an individual sampling result was equal to or less than the practical reporting level, a value of "0" was used for averaging. Monthly averages less than the practical reporting level reflect the fact that some but not all of the individual samples making up the average contained levels greater than the practical reporting level. When one more than on analysis was made in a monthly period, the number of samples in the monthly average is given in parentheses.

[c] Pasteurized Milk Network station. All other sampling locations are part of the State or National network.

[d] Radionuclide analysis not routinely performed.

[e] The practical reporting levels for these networks differ from the general ones given in the text. Sampling results for the networks were equal to or less than the following practical reporting levels:
Cesium-137: Colorado—25 pCi/liter Strontium-90: New York—3 pCi/liter
New York—20pCi/liter
Oregon—15 pCi/liter

[f] This entry gives the average radionuclide concentrations for the Pasteurized Milk Network stations denoted by footnote [c].
NA, no analysis.
NS, no sample.

Data reporting format

Table 2 presents the integrated results of the international, national, and State networks discussed earlier. Column 1 lists all the stations which are routinely reported in *Radiation Data and Reports*. The relationship between the PMN stations and the State stations is shown in figure 2. The first column in table 2 under each of the reported radionuclides gives the monthly average for the station and the number of samples analyzed in that month in parentheses. When an individual sampling result is equal to or below the practical reporting level for the radionuclide, a value of zero is used for averaging. Monthly averages are calculated using the above convention. Averages which are equal to or less than the practical reporting levels reflect the presence of radioactivity in some of the individual samples greater than the practical reporting level.

The second column under each of the radionuclides reported gives the 12-month average for the station as calculated from the preceding

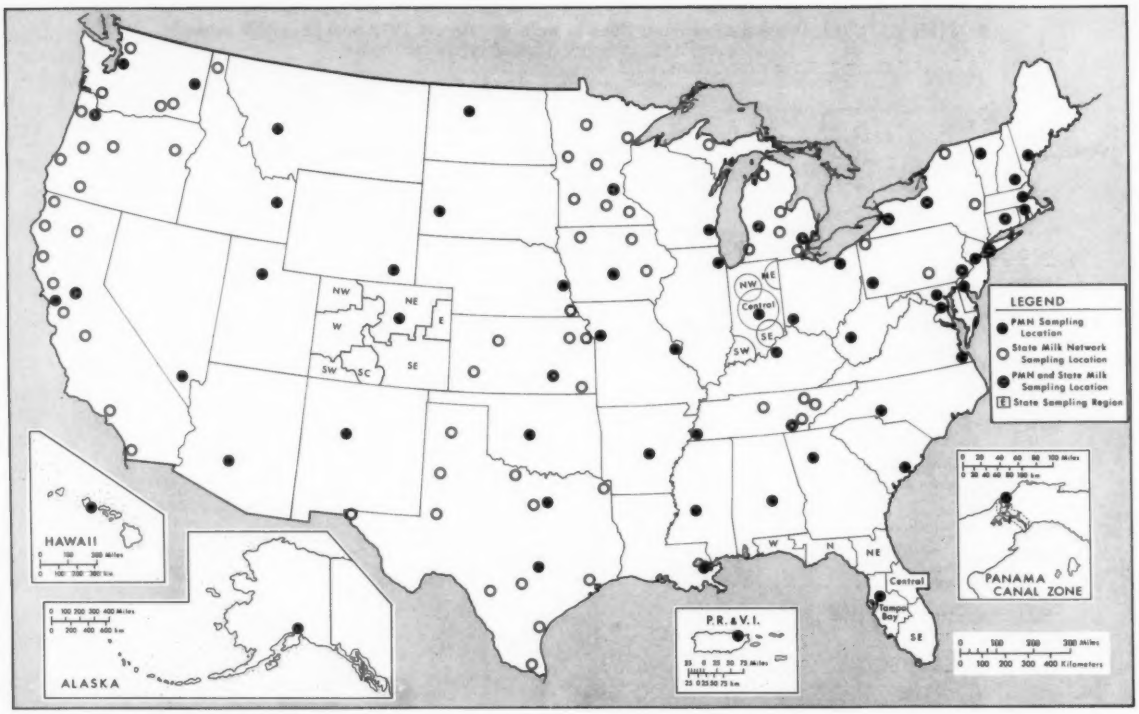

Figure 2. State and PMN milk sampling stations in the United States

12 monthly averages, giving each monthly average equal weight. Since the daily intake of radioactivity by exposed population groups, averaged over a year, constitutes an appropriate criterion for the case where the FRC radiation protection guides apply, the 12-month average serves as a basis for comparison.

Discussion of current data

In table 2, surveillance results are given for strontium-90 and cesium-137 for August 1972 and the 12-month period, September 1971 to August 1972. Except where noted, the monthly average represents a single sample for the sampling station. Strontium-89, iodine-131, and barium-140 data have been omitted from table 2 since levels at the great majority of the stations for August 1972 were below the respective practical reporting levels. Table 3 gives monthly average for those stations at which strontium-89, iodine-131, and barium-140 were detected.

Table 3. Strontium-89, iodine-131, and barium-140 in milk, August 1972

Sampling location		Concentration (pCi/liter)		
		Strontium-89	Iodine-131	Barium-140
Calif:	Shasta (State)	5		
Colo:	Southeast (State)		26	
Kans:	Dodge City (State)	5		
	Kansas City (State)			13
	Wichita (State)	5		
N.Y:	New York City (State)	5		
Colombia:	Bogota	8		

Strontium-90 monthly averages ranged from 0 to 27 pCi/liter in the United States for August 1972, and the highest 12-month average was 18 pCi/liter (Little Falls, Minn.) representing 9.0 percent of the Federal Radiation Council radiation protection guide. Cesium-137 monthly averages ranged from 0 to 82 pCi/liter in the United States for August 1972, and the highest 12-month average was 58 pCi/liter (Southeast Florida) representing 1.6 percent of the value derived from the recommendations given in the Federal Radiation Council report. Of particular interest are the consistently higher cesium-137 levels that have been observed in Florida (*7*) and Jamaica.

Acknowledgment

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California State Department of Health

Radiation Protection Division
Canadian Department of National Health and Welfare

Radiological Health Section
Division of Occupational and Radiological Health
Colorado Department of Health

Radiological Health Services
Division of Medical Services
Connecticut State Department of Health

Radiological and Occupational Health Section
Department of Health and Rehabilitative Services
State of Florida

Bureau of Environmental Sanitation
Division of Sanitary Engineering
Indiana State Board of Health

Division of Radiological Health
Environmental Engineering Services
Iowa State Department of Health

Radiation Control Section
Environmental Health Division
Kansas State Department of Health

Radiological Health Services
Division of Occupational Health
Michigan Department of Health

Radiation Control Section
Division of Environmental Health
State of Minnesota Department of Health

Bureau of Radiological Pollution Control
New York State Department of Environmental Conservation

Environmental Radiation Surveillance Program
Division of Sanitation and Engineering
Oregon State Board of Health

Radiological Health Section
Bureau of Environmental Health
Pennsylvania Department of Public Health

Radiological Health Services
Division of Preventable Diseases
Tennessee Department of Public Health

Division of Occupational Health
Environmental Health Services
Texas State Department of Health

Radiation Control Section
Division of Health
Washington Department of Social and Health Services

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Milk Surveillance Programs, January-March 1972

National Environmental Research Center—Las Vegas, Environmental Protection Agency

The National Environmental Research Center—Las Vegas (NERC-LV) is responsible for conducting radiological safety and environmental surveillance programs in the offsite area surrounding the Nevada Test Site (NTS) in support of nuclear testing sponsored by the U.S. Atomic Energy Commission (AEC)[1] and the Space Nuclear Systems Office (an organizational amalgamation of the AEC and the National Aeronautical and Space Administration). When required, additional surveillance programs are established at locations other than around NTS in support of AEC operations, such as Project Rulison, the Plowshare nuclear explosive engineering experiment near Grand Junction, Colo., in 1970, and in the Cannikin nuclear test on Amchitka Island, Alaska, in 1971. Beginning with this report, the analytical results of milk samples collected for the above programs will be reported in *Radiation Data and Reports.*

The milk surveillance networks operated by the NERC-LV are the routine Milk Surveillance Network (MSN) and the Standby Milk Surveillance Network (SMSN). The MSN, shown in figure 1, consists of 32 regular and 5 alternate locations at which NERC-LV personnel collect 1-gallon milk samples on a monthly basis from family milk cows, commercial pasteurized milk, Grade A raw milk for pasteurization, and Grade A raw milk for local consumption. In the event of a release of

[1] These programs are operated under a Memorandum of Understanding (No. AT (26–1)–539) with the Nevada Operations Office, U.S. AEC, Las Vegas, Nev.

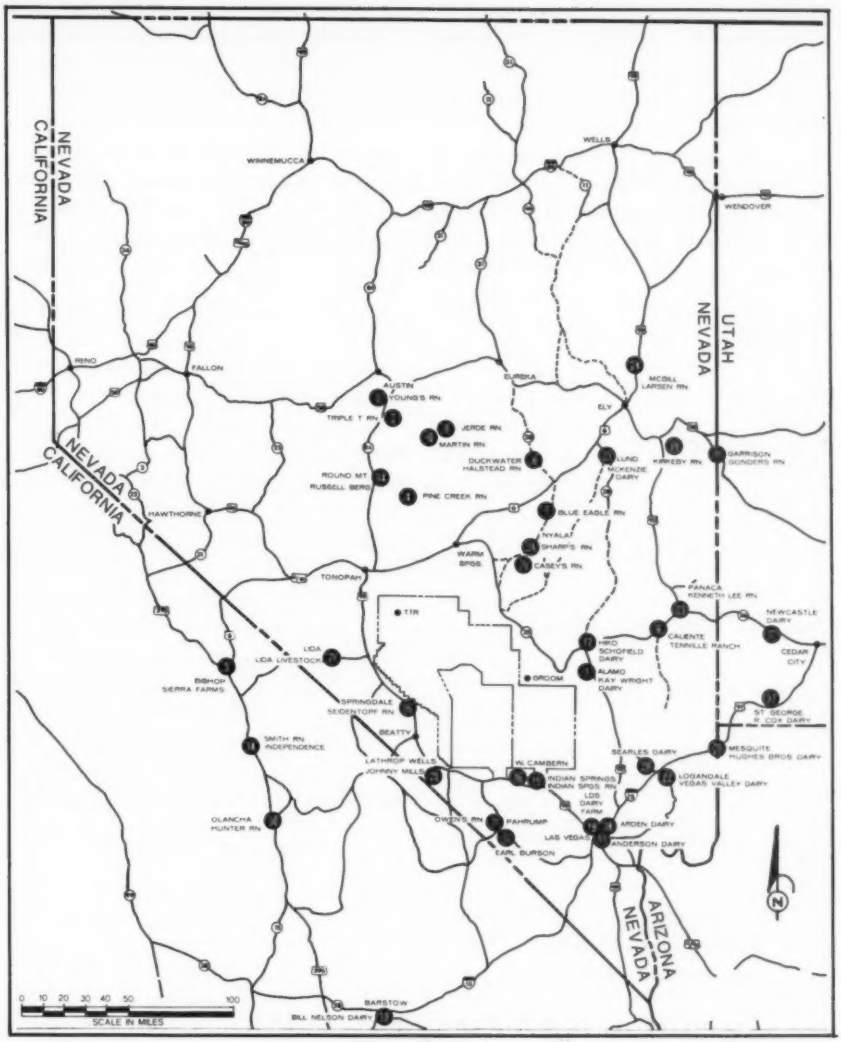

Figure 1. NERC-LV Milk Surveillance Network

radioactivity from the NTS, intensive sampling is conducted in the affected area out to about 300 miles of the NTS to determine radionuclide concentrations in milk, to assess radiation doses that could result from the ingestion of the milk, and to take protective action if required. Milk supplies and producers beyond 300 miles are sampled by the SMSN.

The SMSN (*1*), shown in figure 2, consists of about 185 Grade A milk processing plants which can be requested by telephone to collect raw milk samples representing milksheds sup-

Figure 2. NERC-LV Standby Milk Surveillance Network

plying milk to the plants. Samples from the network are collected and mailed to NERC-LV through the cooperation of federal, state, and local government agencies in the event of a release of radioactivity at NTS or other test locations. Periodically, one sample is collected from each station to maintain network readiness and to check the network's reliability. An exception to this is the sampling procedure used in Texas. The Texas State Health Department does its own analysis and forwards the results to NERC-LV.

During readiness checks, only random samples are analyzed for strontium and tritium.

Since the surveillance programs for Project Rulison and the Cannikin Event were completed last year, no milk samples were collected during 1972. The surveillance programs and analytical results prior to January 1972 for these operations are reported separately *(2-4)*.

Analytical procedures

All routine samples are analyzed for gamma-emitting radionuclides by gamma spectroscopy and for radiostrontium by radiochemistry procedures. Approximately six samples per month from the most prevalent downwind trajectories from the NTS are also analyzed for tritium. Special or event-related samples are normally gamma scanned. Further analyses depend on whether activity is detected and/or on special requirements of the sampling program.

Table 1 lists the general analytical procedures and detection limits, as described by Johns *(5)*, and Lem and Snelling *(6)*. For gamma spectroscopy analyses, the samples are placed in 3.5-liter inverted-well Marinelli beakers.. All routine samples are counted for 40 minutes. Special samples collected following known releases of activity are normally counted 20 minutes, but will vary from 10 to 40 minutes depending on radionuclide concentration and sample workload. The activity concentration of each of the detected nuclides at the time of count is calculated and extrapolated to time of collection.

Results

Table 2 lists the analytical results of all milk samples collected from the NERC-LV MSN in January, February, and March 1972. Alternate stations indicated with an (A), are sampled only if milk is unavailable at a regular station.

As a check on network response, a portion of the SMSN in California was requested to send in one raw milk sample each in March. The analytical results of these samples are shown in table 3.

Copies of these results are distributed to EPA Regional Offices and appropriate state agencies prior to publication.

Table 1. Analytical procedures

Type of analysis	Analytical equipment	Counting period (min.)	Analytical procedures	Sample size (liter)	Detection limits (pCi/liter)
Gamma spectroscopy	Gamma spectrometer with a 10 by 10-cm NaI (Tl) crystal with input to 200 channels (0–2 MeV) of 400-channel, pulse-height analyzer	10–40	Radionuclide concentrations quantitated from gamma spectrometer data by computer using an eight element matrix technique	3.5	Generally 10 pCi/liter for most common fallout radionuclides in a simple spectrum
Strontium-89, strontium-90	Low-background thin-window, gas-flow proportional counter with a 5.7 cm diameter window (80 $\mu g/cm^2$)	50	Chemical separation by ion exchange. Separated sample counted successively; activity calculated by simultaneous equations	1.0	[a] Strontium-89 = 5 [a] Strontium-90 = 2
Tritium	Automatic liquid scintillation counter with output printer	100	Sample prepared by distillation	.005	[a,b] = 320.

[a] The detection limit for a given sample is defined as that concentration which is equal to the 2-sigma counting error.

[b] The detection limit for samples analyzed during February and thereafter was = 220 pCi/liter.

Table 2. Milk surveillance results, January, February, and March 1972

Location	Map number	Date collected (1972)	Sample type[a]	Radionuclide concentrations[b] (pCi/liter)			
				^{137}Cs	^{89}Sr	^{90}Sr	^{3}H
California:							
Bishop:							
Sierra Farms	5	1/6	11	<10	<2	2±1	NA
		2/9	11	<10	<2	<1	NA
		3/6	11	<10	<2	<1	NA
Hinkley:							
Bill Nelson Dairy	13	1/5	12	<10	2±1	<1	NA
		2/8	12	<10	<2	<1	NA
		3/7	12	<10	<2	<1	NA
Independence:							
Smith Ranch	14	NS					
		2/9	13	<10	2±2	2±2	NA
		3/7	13	<10	6±1	<1	NA
Olancha:							
Hunter Ranch	30	1/5	13	[c]<100	<2	4±1	NA
		2/7	13	[c]<100	2±2	2±1	NA
		3/5	13	[c]<100	<2	3±1	NA
Nevada:							
Alamo:							
Wright Dairy	1	1/13	12	10	<2	4±2	NA
		2/8	12	<10	<2	2±2	NA
		3/7	12	<10	<2	3±1	NA
Austin:							
Triple T Ranch	2	1/12	13	<10	<2	3±2	620±320
		2/8	13	10	<2	4±2	610±270
		3/7	13	10	<2	2±1	350±200
Young's Ranch (A)	3	NS					
		NS					
		NS					
Belmont:							
Pine Creek Ranch	4	NS					
		NS					
		NS					
Caliente:							
Young's Ranch	6	NS					
		NS					
		NS					
Currant:							
Blue Eagle Ranch	7	NS					
		2/8	13	20	<2	3±2	NA
		3/8	13	40	<2	3±2	NA
Duckwater:							
Halstead Ranch	8	NS					
		NS					
		3/8	13	20	<2	5±2	NA
Eureka:							
Jerde Ranch (A)	9	NS					
		NS					
		NS					
Martin Ranch	10	1/7	13	20	5±3	4±2	NA
		2/7	13	20	<3	5±2	NA
		3/6	13	20	<3	10±2	NA
Hiko:							
Schofield Dairy	12	1/10	12	<10	<2	3±1	310
		2/8	12	<10	<2	3±2	260
		3/7	12	10	<2	4±1	840±260
Indian Springs:							
Cambern Ranch (A)[e]	16	NS					
		2/8	13	<10	1±1	<1	NA
		NS					
Indian Springs Ranch	15	NS					
		NS					
		NS					
Las Vegas:							
Anderson Dairy	17	1/4	11	<10	<2	3±1	NA
		2/16	11	<10	<2	2±2	NA
		NS					
Arden Dairy	18	1/4	11	<10	<2	<1	NA
		2/16	11	<10	<2	2±1	NA
		NS					
Las Vegas:							
LDS Dairy Farm	19	1/4	12	<10	<2	<1	<290
		2/16	12	<10	<1	2±1	<190
		NS					
Lathrop Wells:							
Mills Ranch	20	1/5	13	<10	2±2	<1	NA
		2/9	13	<10	<1	<1	NA
		3/8	13	<10	<2	<1	NA
Lida:							
Lida Livestock Company	21	1/9	13	<10	<2	4±2	NA
		2/7	13	<10	<2	2±2	NA
		3/5	13	<10	<1	<1	NA
Logandale:							
Vegas Valley Dairy	22	1/10	12	<10	[d]NA	[d]NA	NA
		2/7	12	<10	[d]NA	[d]NA	NA
		3/13	12	<10	<2	3±1	NA

[a] See footnotes at end of table.

Table 2. Milk surveillance results, Janary February, and March 1972—continued

Location	Map number	Date collected (1972)	Sample type[a]	Radionuclide concentrations[b] (pCi/liter)			
				^{137}Cs	^{89}Sr	^{90}Sr	^{3}H
Lund:							
McKenzie Dairy	23	1/11	12	<10	<2	4 ±2	<310
		2/9	12	<10	3 ±2	<2	<310
		3/9	12	10	<2	3 ±1	<250
McGill:							
Larsen Ranch	24	NS					
		NS					
		3/9	13	<10	<1	2 ±1	NA
Mesquite:							
Hughes Bros Dairy	25	1/11	12	<10	<2	2 ±1	<290
		2/9	12	<10	<1	2 ±1	730 ±250
		3/13	12	<10	<1	2 ±1	<200
Moapa:							
Searles Dairy	26	1/10	12	<10	<2	2 ±2	NA
		2/8	12	<10	<2	3 ±2	NA
		3/7	12	<10	<2	3 ±1	NA
Nyala:							
Sharp's Ranch	28	1/11	13	10	<2	2 ±2	<290
		2/10	13	<10	<2	5 ±2	<250
		3/8	13	<10	<2	4 ±2	<200
Casey's Ranch (A)[e]	29	NS					
		NS					
		NS					
Pahrump:							
Earl Burson (A)	32	NS					
		NS					
		NS					
Owens Ranch	31	1/3	13	<10	<1	2 ±1	NA
		2/9	13	<10	1 ±1	<1	NA
		3/10	13	<10	<1	<1	NA
Panaca:							
Kenneth Lee Ranch	33	1/11	13	<10	<2	2 ±1	NA
		2/9	13	<10	<2	2 ±1	NA
		3/8	13	<10	<2	<2	NA
Round Mt:							
Russell Berg	34	NS					
		NS					
		3/7	13	<10	<3	9 ±2	NA
Shoshone:							
Kirkeby Ranch	35	1/12	13	<10	<3	5 ±2	NA
		NS					
		NS					
Springdale:							
McCurdy Ranch	36	1/6	13	[c] <100	<2	2 ±1	NA
		2/9	13	<10	<2	<1	NA
		3/8	13	<10	<1	2 ±1	NA
Utah:							
Garrison:							
Gonders Ranch	11	1/12	13	<10	<2	3 ±2	NA
		2/10	13	<10	<2	3 ±2	NA
		3/7	13	<10	<2	2 ±1	NA
Newcastle:							
Newcastle Dairy	27	1/11	12	<10	<2	2 ±2	NA
		2/9	12	<10	<2	2 ±1	NA
		3/15	12	<10	<2	4 ±1	NA
St. George:							
R. Cox Dairy	37	1/10	12	<10	<2	3 ±2	NA
		2/8	12	<10	<2	4 ±1	NA
		3/14	12	<10	<2	3 ±1	NA

[a] 11, pasteurized milk.
12, raw milk from Grade A producer(s).
13, raw milk from family cow(s).
[b] Two-sigma counting error provided when available.
[c] Small sample size.
[d] Not analyzed because sample was sour.
[e] (A) alternate milk sampling station.
NA, not analyzed.
NS, no sample.

Table 3. Standby Milk Surveillance Network results

Location	Map number	Date collected 1972	Radionuclide concentrations[a] (pCi/liter)			
			^{137}Cs	^{89}Sr	^{90}Sr	^{3}H
California:						
Auburn:						
Lone Star Dairy	326	3/28	<10	NA	NA	NA
Chico:						
Quality Dairy	320	3/27	<10	<3	4±1	<220
Fort Bragg:						
Denevi Dairy	317	3/27	[b,c] <100	NA	NA	NA
Fresno:						
St. College Creamery	339	3/27	<10	<2	2±1	<220
Madera:						
Madera Quality Dairy	337	3/26	<10	NA	NA	NA
Merced:						
Sunshine Dairy Farms	336	3/27	<10	NA	NA	NA
Redding:						
McColl's Dairy Prod	315	3/27	<10	<3	2±1	<220
Salinas:						
Blue Ribbon Dairy	334	3/27	[b] <100	<2	<1	<200
San Jose:						
Pleasant Hill Dairy	330	3/26	<10	NA	NA	NA
Santa Clara:						
Edelweiss Dairies	348	3/29	<10	NA	NA	NA
Santa Rosa:						
Arlington Farms	323	3/27	<10	<3	2±1	<220
Burbank Dairy	324	3/26	<10	NA	NA	NA
Susanville:						
Morning Glory Dairy	316	3/26	<10	<3	5±2	<220
Tracy:						
Deuel Voc. Inst.	350	3/27	<10	NA	NA	NA
Watsonville:						
Monte Vista Dairy	579	3/27	<10	NA	NA	NA
	579	3/28	<10	NA	NA	NA
Willits:[c]						
Ridgewood Ranch Dairy	None	3/27	<10	<4	6±2	240±200

[a] Two-sigma counting error provided when available.
[b] Small sample size.
[c] New sampling location.
NA, not analyzed.

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(*4*) FORT, C. W. and D. T. WRUBLE. Final Report of Off-Site Radiological Safety for the Cannikin Event, November 6, 1971, NERC–LV–539–2. Western Environmental Research Laboratory, EPA, Las Vegas, Nev. (to be published).

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Foods and Diet Surveillance

Efforts are being made by various Federal and State agencies to estimate the dietary intake of selected radionuclides on a continuing basis. These estimates, along with the guidance developed by the Federal Radiation Council, provide a basis for evaluating the significance of radioactivity in foods and diet.

Networks presently in operation and reported routinely include those listed below. These networks provide data useful for developing estimates of nationwide dietary intake of radionuclides. Programs reported in *Radiation Data and Reports* are as follows:

Program	Period reported	Issue
Carbon-14 in Total Diet and Mlik	July–December 1971	May 1972
Connecticut Standard Diet	January–December 1970	December 1971
Institutional Total Diet	October–December 1971 and 1971 Annual Summary	June 1972
Radiostrontium in Milk	January–December 1971	November 1972
Strontium-90 in Tri-City Diets	January–December 1970	November 1971

Estimated Daily Intake of Radionuclides in California Diets, January-June 1971

Bureau of Radiological Health
California State Department of Public Health

Since January 1964, the Bureau of Radiological Health, California State Department of Public Health, has made estimates of radionuclide levels in the diets of Californians (*1*).

Recognizing that a "standard" or "typical" diet does not exist due to variations in individual tastes, an effort was made to select a diet which was reasonably representative of the food consumed in a given area. This objective was met by utilizing the "house" diet of a hospital in each of the 20 geographic areas of interest (figure 1).

Hospitals were chosen as the source of diet samples under the hypothesis that their diets are as "reasonably representative" as any other. General hospitals exist in each of the 20 selected geographic areas and operate with trained dietitians. There is good reason to believe that hospitals utilize foods which are marketed in their respective communities.

Sampling procedure

In general, the sampling procedure is the same at each hospital. Samples are collected every 3 months at each facility. Each sample represents the edible portion of a regular meal (the standard diet) for a full 7-day week (21 consecutive meals).

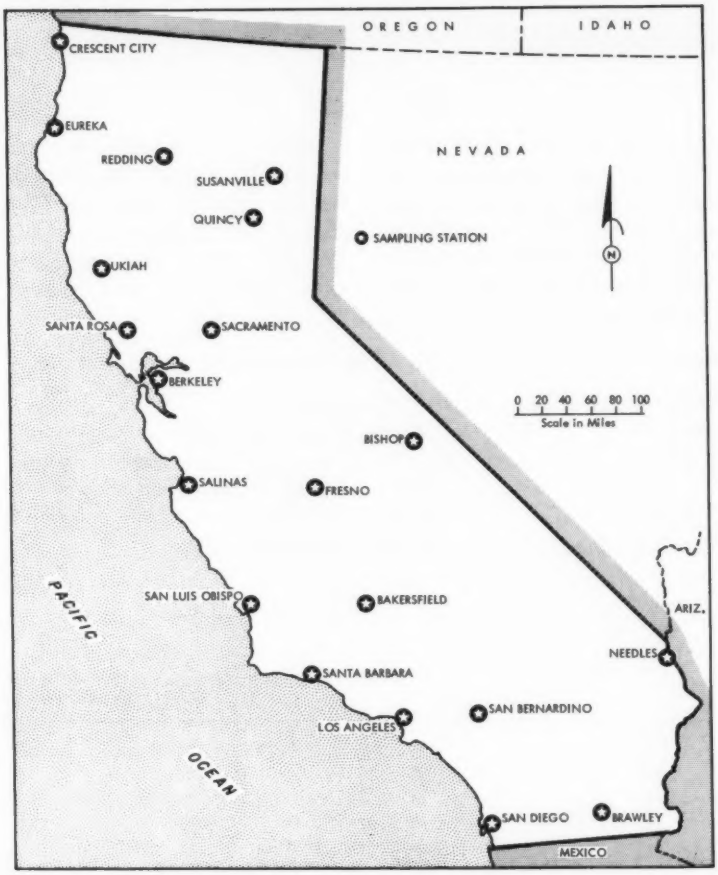

Figure 1. California diet sampling stations

After each sample is collected, it is suitably preserved and shipped to the Sanitation and Radiation Laboratory of the State Department of Public Health. Accompanying each sample is a record prepared by the dietitians indicating the types and quantities of food included.

Analytical procedures

After weighing at the laboratory, each sample is homogenized and analyzed for gamma-ray emitters, then dried and ashed prior to analysis for strontium-89, strontium-90, radium-226, and stable calcium, strontium, and sodium.

Data and discussion

The resultant estimates of daily intake of radionuclides in the California diets are given in table 1 (January-March 1971) and table 2 (April-June 1971).

Table 1. Estimated daily intake of radionuclides in California diets,[a] January–March 1971

City	Consumption (kg/capita-day)[b]	Intake (pCi/capita-day)							Intake (g/capita-day)		
		^{89}Sr	^{90}Sr	^{226}Ra	^{137}Cs	^{95}Zr	^{54}Mn	$^{141-144}Ce$	K[c]	Na	Ca
Bakersfield	2.2	0	8	0.8	0	7	19	0	4.4	3.0	1.1
Berkeley	2.1	2	6	1.6	3	4	17	0	4.1	3.1	.8
Bishop	2.0	0	6	.8	3	5	17	0	3.1	3.1	.8
Brawley	2.4	1	8	1.3	0	6	18	1	4.8	3.0	1.4
Crescent City	2.2	3	12	1.3	5	4	18	0	4.1	3.2	.9
Eureka	2.2	2	7	1.0	1	4	17	0	4.0	2.8	.9
Fresno	1.9	1	5	1.5	0	5	18	0	2.7	2.7	1.0
Los Angeles	2.0	2	5	1.0	0	3	20	0	2.8	3.4	.8
Needles	2.2	2	6	.6	0	2	18	0	2.9	2.7	1.1
Quincy	2.3	0	7	1.4	0	1	17	0	2.9	2.5	.7
Redding	2.0	2	7	1.1	0	1	16	2	3.0	2.8	1.5
Sacramento	2.2	4	5	.9	1	5	13	0	2.9	4.4	.9
Salinas	2.5	0	7	1.0	0	5	19	0	6.7	3.6	.8
San Bernardino	2.3	0	7	.7	1	9	21	3	4.3	3.4	1.2
San Diego	2.2	3	5	1.1	0	5	20	0	3.1	3.2	1.2
San Luis Obispo	1.9	7	5	1.2	3	8	15	0	2.9	4.1	1.2
Santa Barbara	2.3	2	7	.9	0	5	15	0	3.0	3.6	1.0
Santa Rosa	1.6	3	5	1.0	0	8	12	0	2.2	3.3	.6
Susanville	1.5	2	4	1.0	0	5	9	0	2.1	3.1	.6
Ukiah	2.6	3	6	1.0	0	4	17	0	2.9	3.3	1.2

[a] Based on analyses of Hospital Standard Diets located in listed cities.
[b] Kilograms of food per person per day in this diet.
[c] Natural potassium contains 0.0119 percent of radioactive potassium-40.
NA, no analysis.

Table 2. Estimated daily intake of radionuclides in California diets,[a] April–June 1971

City	Consumption (kg/capita-day)[b]	Intake (pCi/capita-day)							Intake (g/capita-day)		
		^{89}Sr	^{90}Sr	^{226}Ra	^{137}Cs	^{95}Zr	^{54}Mn	$^{141-144}Ce$	K[c]	Na	Ca
Bakersfield	2.1	3	4	0.8	0	7	13	0	2.9	4.0	1.0
Berkeley	1.7	2	4	1.1	0	5	15	0	2.6	3.8	.8
Bishop	1.8	3	3	.8	0	7	17	0	2.7	2.5	.6
Brawley	2.1	4	5	.5	0	2	19	0	2.6	4.0	.7
Crescent City	2.3	39	23	1.4	17	0	18	0	4.1	5.5	1.4
Eureka	2.0	7	6	.9	4	2	17	0	2.5	4.1	.6
Fresno	2.1	3	5	2.1	1	6	17	0	3.1	3.1	1.3
Los Angeles	1.9	2	7	1.3	3	4	17	0	2.7	3.8	.7
Needles	2.4	4	5	.7	0	7	15	0	2.9	3.3	.9
Quincy	2.1	4	5	1.4	1	4	19	0	3.1	3.5	.7
Redding	1.6	2	4	.9	1	3	16	0	2.1	2.7	.9
Sacramento	2.7	5	8	1.2	1	8	18	0	3.5	5.3	1.3
Salinas	2.3	0	6	1.0	2	4	17	0	2.9	6.5	.8
San Bernardino	2.2	6	4	1.4	0	5	20	0	3.2	4.4	1.3
San Diego	2.2	0	7	.9	0	8	18	0	3.2	2.8	1.0
San Luis Obispo	1.9	4	5	1.6	0	11	17	0	3.1	3.5	1.3
Santa Barbara	2.0	1	4	.9	0	5	17	0	3.0	2.8	.8
Santa Rosa	1.8	1	7	.2	3	2	13	0	2.2	3.4	.8
Susanville	1.1	2	3	.7	2	1	8	0	1.3	2.8	.3
Ukiah	1.9	2	4	1.3	0	8	19	0	2.9	3.2	1.3

[a] Based on analyses of Hospital Standard Diets located in listed cities.
[b] Kilograms of food per person per day in this diet.
[c] Natural potassium contains 0.0119 percent of radioactive potassium-40.
NA, no analysis.

It should be noted that levels of radioactivity were observed to be far below those levels for which consideration should be given to protective health action.

A summary of strontium-90 and cesium-137 intake trends in California diets from January 1964 through June 1971 is given in figures 2 and 3.

Recent coverage in *Radiation Data and Reports*

Period	Issue
July–December 1970	November 1971

REFERENCE

(1) STATE OF CALIFORNIA DEPARTMENT OF PUBLIC HEALTH, BUREAU OF RADIOLOGICAL HEALTH. Radiol Health News 4:4 (October 1965). 2151 Berkeley Way, Berkeley, Calif. 94704.

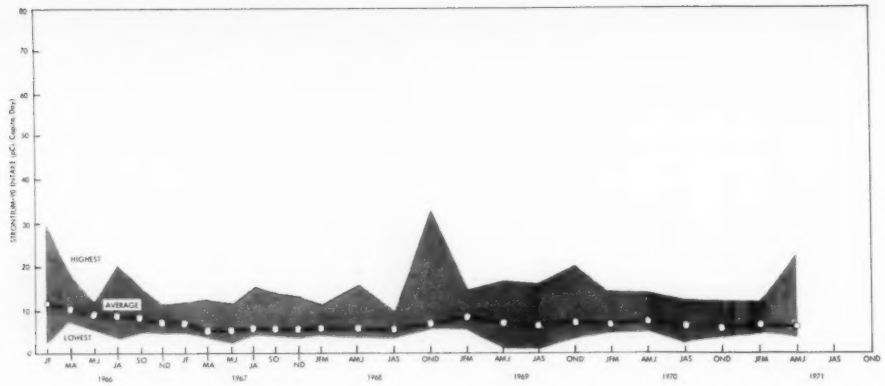

Figure 2. Averages and ranges of daily strontium-90 intake in California diets

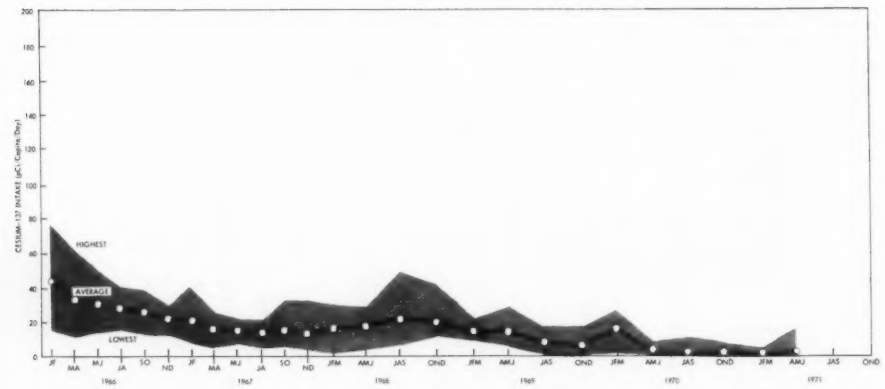

Figure 3. Averages and ranges of daily cesium-137 intake in California diets

Estimated Daily Intake of Radionuclides in Connecticut Standard Diet January-December 1971

Connecticut State Department of Health

The Connecticut State Department of Health has been analyzing a standard diet on a monthly basis since March 1963. Analyses are made for strontium-89, strontium-90, and gamma-ray emitters.

The standard diet was selected to represent the food intake of an 18-year old boy for 1 day (table 1). The total weight of the complete blended diet, averaging 3 kilograms, included milk and dairy products. When raw fruit or vegetables were sampled, they were washed before blending.

Table 1. Foods included in standard diet

Bread, white—8 slices	Ice cream—½ pint
Butter, ½ stick	Lettuce, washed—4.5 leaves
Carrots, scraped—½ cup	Milk—3 cups
Celery, washed and trimmed—3 stalks	Oatmeal—uncooked—43 grams
Cookies—4	Orange—1
Cottage cheese— ⅔ cup	Peanut butter—2½ tablespoons
Cupcakes—2	Pears, canned—2 halves with juice
Egg—1	Potatoes, washed, not peeled—2
Green beans, washed—½ cup	Sugar—5 tablespoons
Ham—85 grams	Tomato juice—113 grams
Hamburger—227 grams	Tuna fish, drained—43 grams

Cesium-137 concentrations were determined by gamma-ray spectrometry (*1*). Strontium-89 and strontium-90 concentrations were determined by chemical separation techniques (*1*).

Table 2 presents the analytical results for the Connecticut standard diet from January through December 1971. Results representative

Table 2. Radionuclide concentrations in Connecticut standard diet, [a] January–December 1971

Month (1971)	Potassium (g/kg)	Strontium-90 (pCi/kg)	Cesium-137 (pCi/kg)
January	2.2	5.7	20
February	2.1	5.7	20
March	2.5	6.4	20
April	2.1	6.5	30
May	2.2	7.1	40
June	2.0	6.8	30
July	2.4	7.7	10
August	2.1	8.6	20
September	2.0	8.0	10
October	2.0	7.8	10
November	(b)	(b)	(b)
December	(b)	(b)	(b)

[a] All strontium-89 values were below the detectable level for this period.
[b] Teenage diet discontinued as of November 1971.

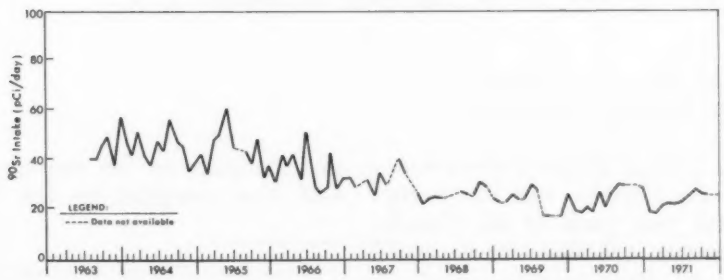

Figure 1. Strontium-90 intake in Connecticut standard diet 1963–December 1971

of the total daily intake for the radionuclides observed are presented in table 3.

In order to evaluate general trends, the strontium-90 and cesium-137 daily intakes are plotted as a function of time in figures 1 and 2.

REFERENCE

(1) CONNECTICUT STATE DEPARTMENT OF HEALTH. Estimated daily intake of radionuclides in Connecticut standard diet, March 1963–December 1964. Radiol Health Data 6:381–382 (July 1965).

Table 3. Daily radionuclide intakes in Connecticut standard diet, [a] January–December 1971

Month (1971)	Potassium (g/day)	Strontium-90 (pCi/day)	Cesium-137 (pCi/day)
January	7.1	18.4	70
February	6.8	18.0	50
March	8.0	20.2	60
April	7.0	21.7	85
May	6.7	21.5	120
June	6.5	21.7	100
July	7.6	24.6	30
August	6.7	26.9	70
September	6.4	25.5	50
October	6.3	24.2	30
November[b]			
December[b]			

[a] All strontium-89 values were below the detectable level for this period.
[b] Teenage diet discontinued as of November 1971.

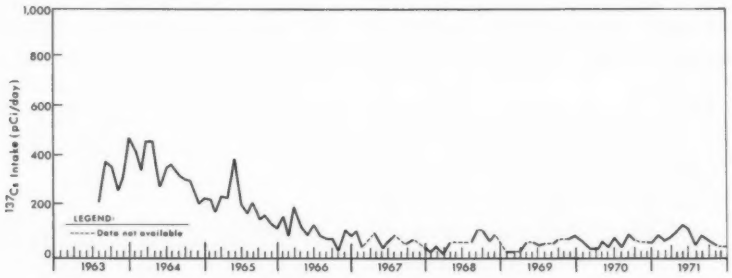

Figure 2. Cesium-137 intake in Connecticut standard diet 1963–December 1971

Recent coverage in *Radiological Health Data and Reports:*

Period	Issue
January–December 1970	December 1971

Strontium-90 in Tri-City Diets, January-December 1971

Health and Safety Laboratory
U.S. Atomic Energy Commission

Estimates of the average intake of strontium-90 by New York City, Chicago, and San Francisco residents have been made by the Health and Safety Laboratory (*HASL*). These estimates were made by using measurements of the strontium-90 content of a large variety of foods purchased at the cities every 3 months and statistics on the average consumption of each food compiled by the U.S. Department

[1] Data from Fallout Program Quarterly Summary Report, HASL 243, 246, and 249. Available from the Clearinghouse for Federal Scientific and Technical Information, CFSTI, 5285 Port Royal Road, Springfield, Va. 22151.

of Agriculture in their 1955 Household Diet Survey (*1*). A detailed description of the aims and methods of the *HASL* diet sampling program along with a summary of the results obtained during the first 3 years of operation (1960–1963) was published earlier (*2*).

In 1968, two changes were made in the program. The first change was the suspension of the collection and analysis of foods purchased in Chicago. Previous experience had shown the levels of strontium-90 in the Chicago diet to be consistently between those of New York

Table 1. Average dietary consumption and strontium-90 intake in Tri-City diet, January–March 1971[a]

Food category	Diet (kg/a)	Calcium (g/a)	New York City February 1971		San Francisco March 1971	
			Strontium-90		Strontium-90	
			(pCi/kg)	(pCi/a)	(pCi/kg)	(pCi/a)
Dairy products	200	216.0	8.9	1,790	2.9	583
Fresh fruit	59	9.4	15.4	907	3.5	205
Fresh vegetables	48	18.7	11.9	571	1.5	75
Root vegetables	10	3.8	8.3	83	5.4	54
Potatoes	38	3.8	7.3	277	1.4	54
Macaroni	3	.6	4.4	13	2.9	9
Rice	3	1.1	2.2	7	.8	2
Fruit juices	28	2.5	3.9	108	1.6	46
Canned vegetables	22	4.4	11.8	260	3.4	75
Canned fruit	11	.6	1.3	14	1.3	15
Dried beans	3	2.1	50.9	153	21.0	63
Flour	34	6.5	7.9	267	5.9	202
Bakery products	44	53.7	4.9	214	4.4	192
Whole grain products	11	10.3	12.3	135	8.5	94
Fresh fish	8	7.6	.4	3	.4	3
Shellfish	1	1.6	1.2	1	.6	1
Poultry	20	6.0	.7	13	.6	11
Meat	79	12.6	.5	42	.3	23
Eggs	15	8.7	2.0	30	1.7	26
Annual intake (pCi/a)		370		4,888		1,733
Daily intake (pCi/g Ca)				13.2		4.7

[a] No samples for January 1971.

Table 2. Average dietary consumption and strontium-90 intake in Tri-City diet, April–June 1971[a]

Food category	Diet (kg/a)	Calcium (g/a)	New York City May 1971		San Francisco June 1971	
			Strontium-90		Strontium-90	
			(pCi/kg)	(pCi/a)	(pCi/kg)	(pCi/a)
Dairy products	200	216.0	9.3	1,860	2.9	583
Fresh fruit	59	9.4	14.2	840	2.6	151
Fresh vegetables	48	18.7	19.0	914	2.0	95
Root vegetables	10	3.8	6.3	63	3.3	33
Potatoes	38	3.8	6.8	259	.6	21
Macaroni	3	.6	4.5	14	3.6	11
Rice	3	1.1	1.9	6	2.4	7
Fruit juices	28	2.5	3.5	99	2.8	79
Canned vegetables	22	4.4	2.3	50	3.1	68
Canned fruit	11	.6	1.6	18	1.7	19
Dried beans	3	2.1	8.4	25	17.2	52
Flour	34	6.5	7.7	263	4.9	166
Bakery	44	53.7	8.5	372	3.8	166
Whole grain products	11	10.3	13.2	145	6.5	71
Fresh fish	8	7.6	1.2	10	.3	2
Shellfish	1	1.6	1.1	1	.4	<1
Poultry	20	6.0	.9	19	1.1	21
Meat	79	12.6	.6	48	.7	52
Eggs	15	8.7	2.2	33	2.3	34
Annual intake (pCi/a)		370		5,039		1,632
Daily intake (pCi/g Ca)				13.6		4.4

[a] No samples for April 1971.

City and San Francisco. Thus, reasonable estimates of the dietary intake of strontium-90 in Chicago at any time can be made from the analyses of foods purchased in New York City and San Francisco.

The second change, revision of the estimates of the annual consumption of different diet components, was made because new information became available. This new information on the composition of the diet appeared in a preliminary report of the U.S. Department of Agriculture in their 1965 Household Diet Sur-

Table 3. Average dietary consumption and strontium-90 intake in Tri-City diet, July–Sep ember 1971[a]

Food category	Diet (kg/a)	Calcium (g/a)	New York City August 1971		San Francisco September 1971	
			Strontium-90		Strontium-90	
			(pCi/kg)	(pCi/a)	(pCi/kg)	(pCi/a)
Dairy products	200	216.0	7.9	1,586	1.5	292
Fresh fruit	59	9.4	2.7	157	2.1	121
Fresh vegetables	48	18.7	20.2	970	1.9	89
Root vegetables	10	3.8	3.2	32	3.7	37
Potatoes	38	3.8	4.1	156	.8	28
Macaroni	3	.6	6.2	19	3.5	11
Rice	3	1.1	2.9	9	2.7	8
Fruit juices	28	2.5	3.6	100	2.7	75
Canned vegetables	22	4.4	9.4	207	3.8	83
Canned fruit	11	.6	1.2	13	1.1	12
Dried beans	3	2.1	18.1	54	13.5	41
Flour	34	6.5	10.6	359	3.7	125
Bakery products	44	53.7	5.8	254	3.8	168
Whole grain products	11	10.3	17.9	197	7.8	86
Fresh fish	8	7.6	.3	2	.7	5
Shell fish	1	1.6	2.5	2	1.4	1
Poultry	20	6.0	1.4	27	1.0	19
Meat	79	12.6	1.0	76	.6	49
Eggs	15	8.7	2.9	43	1.5	23
Annual intake (pCi/a)		370		4,264		1,273
Daily intake (pCi/g Ca)				11.5		3.4

[a] No samples for July 1971.

Table 4. Average dietary consumption and strontium-90 intake in Tri-City diet, October–December 1971[a]

Food category	Diet (kg/a)	Calcium (g/a)	New York City November 1971		San Francisco December 1971	
			Strontium-90		Strontium-90	
			(pCi/kg)	(pCi/a)	(pCi/kg)	(pCi/a)
Dairy products	200	216.0	6.8	1,363	1.2	248
Fresh fruit	59	9.4	13.1	771	2.1	121
Fresh vegetables	48	18.7	15.6	747	3.6	172
Root vegetables	10	3.8	11.3	113	6.0	60
Potatoes	38	3.8	10.1	385	1.1	42
Macaroni	3	.6	4.2	13	2.8	8
Rice	3	1.1	2.7	8	2.0	6
Fruit juices	28	2.5	3.8	107	2.4	68
Canned vegetables	22	4.4	7.1	156	2.8	62
Canned fruit	11	.6	1.1	12	1.0	11
Dried beans	3	2.1	18.9	57	9.7	29
Flour	34	6.5	9.2	314	.4	15
Bakery products	44	53.7	5.8	257	3.2	140
Whole grain products	11	10.3	10.7	118	7.1	78
Fresh fish	8	7.6	.3	2	.3	2
Shellfish	1	1.6	1.2	1	.7	1
Poultry	20	6.0	.9	18	.4	8
Meat	79	12.6	.4	32	.3	24
Eggs	15	8.7	1.4	21	1.0	15
Annual intake (pCi/a)		370		4,495		1,110
Daily intake (pCi/g Ca)				12.1		3.0

[a] No samples for October 1971.

vey (*3*). The changes in the composition of the diet from 1955 to 1965 are not very great, and the estimates of strontium-90 intake made using statistics from either diet survey are not too different. Estimates of the intakes of other nuclides, however, may be affected to a greater degree. The new estimates of the consumption have therefore been used to calculate the intakes of calcium and strontium-90 for 1971 in New York City and San Francisco.

Results for January–December 1971 are presented in tables 1 through 4. The variation with time of the daily intake of strontium-90 in the three cities is plotted in figure 1.

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(*1*) U.S. DEPARTMENT OF AGRICULTURE. Food consumption of households in the United States, household food consumption survey, Report No. 1 (1955). Superintendent of Documents, Government Printing Office, Washington, D.C. 20402 (December 1956).

(*2*) RIVERA, J. and J. H. HARLEY. HASL contributions to the study of fallout in food chains, HASL–137. Office of Technical Services, U.S. Atomic Energy Commission, New York, N.Y. (July 1, 1964).

(*3*) U.S. DEPARTMENT OF AGRICULTURE. Food consumption of households in the United States, spring 1965, A Preliminary Report. USDA, ARS 62–16 (August 1967).

Recent coverage in *Radiological Health Data and Reports:*

Period	Issue
January–December 1970	November 1971

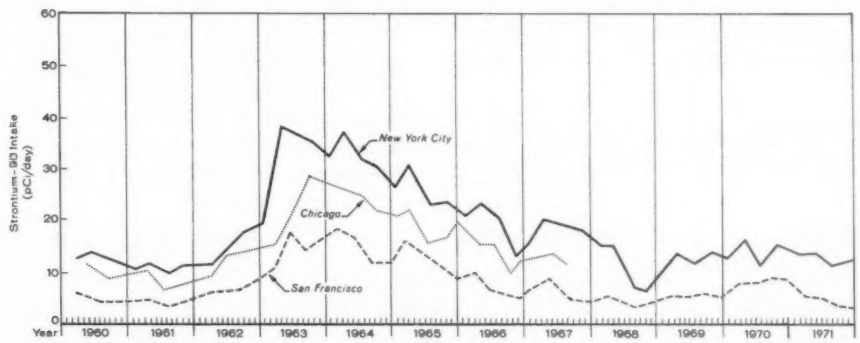

Figure 1. Daily intake of strontium-90 in Tri-City diets, 1960–December 1971

SECTION II. WATER

The Environmental Protection Agency and other Federal, State, and local agencies operate extensive water quality sampling and analysis programs for surface, ground, and treated water. Most of these programs include determinations of gross beta and gross alpha radioactivity and specific radionuclides.

Although the determination of the total radionuclide intake from all sources is of primary importance, a measure of the public health importance of radioactivity levels in water can be obtained by comparison of the observed values with the Public Health Service Drinking Water Standards (*1*). These standards, based on consideration of Federal Radiation Council (FRC) recommendations (*2-4*) set the limits for approval of a drinking water supply containing radium-226 and strontium-90 at 3 pCi/liter and 10 pCi/liter, respectively. Higher concentrations may be acceptable if the total intake of radioactivity from all sources remains within the guides recommended by FRC for control action. In the known absence[1] of strontium-90 and alpha-particle emitters, the limit is 1,000 pCi/liter gross beta radioactivity, except when additional analysis indicates that concentrations of radionuclides are not likely to cause exposures greater than the limits indicated by the Radiation Protection Guides. Surveillance data from a number of Federal and State programs are published periodically to show current and long-range trends. Water sampling activities reported in *Radiation Data and Reports* are listed below.

[1] Absence is taken to mean a negligibly small fraction of the specific limits of 3 pCi/liter and 10 pCi/liter for unidentified alpha-particle emitters and strontium-90, respectively.

Water sampling program	Period reported	Issue
California	January–December 1970	June 1972
Colorado River Basin	1968	March 1972
Community Water Supply Study	1969	September 1972
Florida	1969	January 1972
Interstate Carrier Drinking Water	1971	May 1972
Kansas	January–December 1970	December 1971
Michigan	January–June 1970	November 1971
Minnesota Municipal Water	July 1970–June 1971	November 1972
New York	July–December 1970 and January–June 1971	May 1972
North Carolina	1969	January 1972
Radiostrontium in Tap Water, *HASL*	July–December 1971	November 1972
Washington	July 1969–June 1970	March 1972
Water Surveillance Programs	January–March 1972	December 1972

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(*1*) U.S. PUBLIC HEALTH SERVICE. Drinking water standards, revised 1962, PHS Publication No. 956. Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402 (March 1963).

(*2*) FEDERAL RADIATION COUNCIL. Radiation Protection Guidance for Federal Agencies. Memorandum for the President, September 1961. Reprint from the Federal Register of September 26, 1961.

(*3*) FEDERAL RADIATION COUNCIL. Background material for the development of Radiation Protection Standards, Report No. 1. Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402 (May 1960).

(*4*) FEDERAL RADIATION COUNCIL. Background material for the development of Radiation Protection Standards, Report No. 2. Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402 (September 1961).

Gross Radioactivity in Surface Waters of the United States, April 1972

Office of Air and Water Programs
U.S. Environmental Protection Agency

The monitoring of gross radioactivity in surface waters of the United States was initiated in 1957 as part of the Water Pollution Surveillance System (formerly National Water Quality Network) of the U.S. Public Health Service. Currently, the program is operated by the U.S. Environmental Protection Agency, Office of Air and Water Programs. Regional offices of the Environmental Protection Agency are responsible for the collection of samples and the entering of the resulting data into the analytical storage and retrieval system. Radio-

Table 1. Gross radioactivity in U.S. surface waters, April 1972

River and station	Number of grab samples	Gross alpha radioactivity (pCi/liter)		Gross beta radioactivity (pCi/liter)	
		Suspended solids	Dissolved solids	Suspended solids	Dissolved solids
Clinch River:					
Kingston, Tenn.	3	<0.2	<0.2	4	7
		<.2	.5	4	6
		.3	<.4	<2	6
Colorado River:					
DeBeque, Colo.	1	.8	2.3	<2	6
Moab, Utah Highway bridge	4	1.7	9.6	7	35
		2.3	5.5	6	15
		<1.8	<3.6	5	22
		6.1	4.9	18	9
Above Mill Creek	4	1.5	10.8	9	21
		2.8	12.2	10	33
		1.5	7.4	17	28
		9.3	3.9	19	9
Dolores River:					
Bedrock, Colo.	4	.3	4.7	5	14
		2.1	2.9	12	17
		.7	1.3	3	4
		11.0	1.0	37	6
Gateway, Colo.	4	.4	5.6	5	28
		1.5	7.0	5	26
		.6	3.9	6	26
		6.6	13.4	15	42
Mississippi River:					
Burlington, Iowa	1	<.5	1.7	3	8
Ohio River:					
Cincinnati, Ohio (Dam #27)	4	.3	.5	<2	3
		5.5	.4	12	3
		8.1	.6	31	4
		2.0	.6	17	7
Roanoke River:					
John Kerr Dam, Va.	4	.3	<.2	4	3
		<.3	<.3	<2	4
		<.3	<.3	<2	3
		<.4	<.5	2	4
San Juan River:					
Bluff, Utah	1	7.7	1.5	30	6
San Miguel River:					
Uravan, Colo.	3	<.3	1.9	<2	5
		<.4	2.0	3	<4
		<.5	<2.3	2	7
Below Uravan, Colo.	4	.7	11.8	4	16
		.6	7.0	4	17
		<.6	2.8	4	11
		1.0	6.8	6	23
Naturita, Colo.	4	<.2	1.1	5	12
		<.3	1.2	<2	7
		<1.0	<2.0	2	6
		.8	.9	6	9
St. Lawrence River:					
Massena, N.Y.	4	<.2	<.4	5	7
		<.3	.6	<2	4
		<.4	<.8	2	6
		<.4	<.7	2	6
White River:					
Watson, Utah	1	<2.3	<2.0	5	4

activity analyses are performed in the centralized laboratories of the Office of Air and Water Programs (Cincinnati, Ohio).

The regular reporting of gross radioactivity data in *Radiological Health Data and Reports* was terminated with the publication of data for October 1968 (April 1969 issue). With the publication of data for January 1971, this activity was resumed as a monthly report series. The unpublished data for the time interval of November 1968 through December 1970 will be the subject of a future summary article.

Table 1 presents the gross alpha and beta radioactivity results for samples collected from 10 rivers during April 1972. The analytical procedures used for determining gross alpha and beta radioactivity are described in the 13th Edition of *Standard Methods for the Examination of Water and Wastewater* (*1*). Results are reported for the date of counting and are not corrected to the date of collection. The sensitivity in counting is that defined by the National Bureau of Standards, Handbook 86 (*2*) and is calculated to be <0.2 pCi/liter for gross alpha radioactivity and <1 pCi/liter for gross beta radioactivity measurements.

REFERENCES

(*1*) AMERICAN PUBLIC HEALTH ASSOCIATION: AMERICAN WATER WORKS ASSOCIATION AND WATER POLLUTION CONTROL FEDERATION. Standard methods for the examination of water and wastewater, 13th Edition, New York, N.Y. (1971).

(*2*) U.S. DEPARTMENT OF COMMERCE. Radioactivity, Recommendations of the International Commission on Radiological Units and Measurements (1962), NBS Handbook 86 (November 29, 1963).

Water Surveillance Programs, January-March 1972

National Environmental Research Center—Las Vegas, Environmental Protection Agency

The National Environmental Research Center—Las Vegas (NERC-LV) is responsible for conducting a radiological safety and environmental surveillance program in the offsite area surrounding the Nevada Test Site (NTS) in support of nuclear testing sponsored by the U.S. Atomic Energy Commission (AEC)[1] and the Space Nuclear Systems Office (an organizational amalgamation of the AEC and the

[1] These programs are operated under a Memorandum of Understanding (NO. AT (26–1)–539) with the Nevada Operations Office, AEC, Las Vegas, Nev.

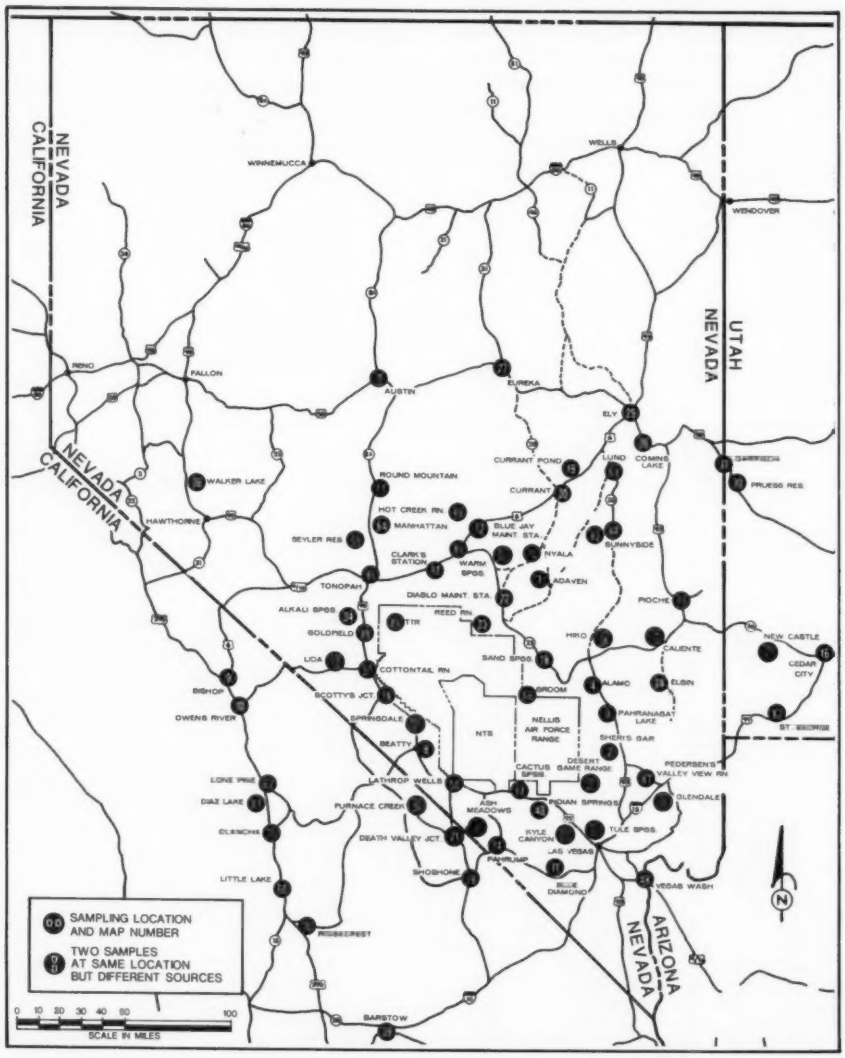

Figure 1. Water Surveillance Network

National Aeronautical and Space Administration). When required, additional surveillance programs are established at locations other than around the NTS in support of AEC operations, such as Project Rulison, the Plowshare nuclear explosive engineering experiment near Grand Junction, Colo. in 1970, and the Cannikin nuclear test on Amchitka Island, Alaska in 1971. Beginning with this report, the analytical results of water samples collected for the above programs will be reported in *Radiation Data and Reports.*

The Water Surveillance Network, operated in offsite areas around the NTS, consists of 90 sampling locations (figures 1 and 2) where NERC-LV personnel collect 1-gallon water samples from wells, open and closed springs, lakes, and ponds on a monthly or quarterly basis. In the event of a release of radioactivity from the NTS, special sampling within the affected area

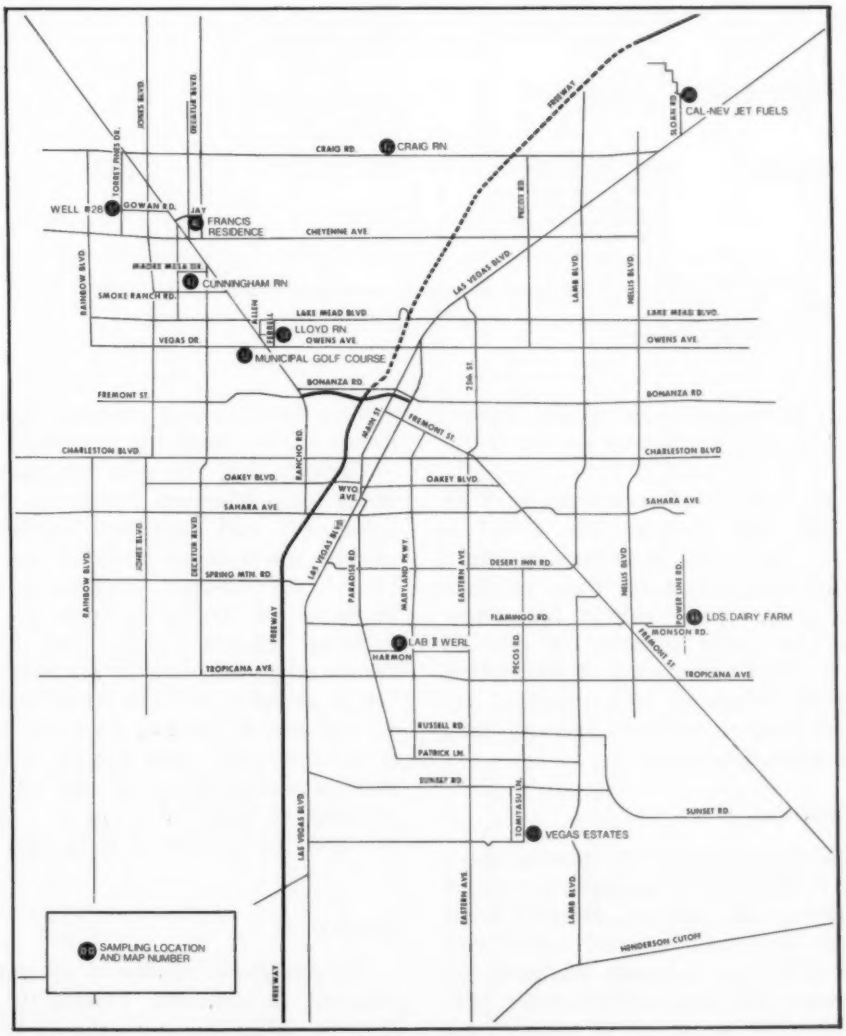

Figure 2. Water Surveillance Network, Las Vegas Valley

Table 1. Analytical procedures

Type of analysis	Analytical equipment	Counting period (min.)	Analytical procedures	Sample size (liter)	Detection limits (pCi/liter)
Gamma[a]	Gamma spectrometer with a 10 by 10 cm NaI(Tl) crystal with input to 200 channels (0–2 MeV) of 400-channel pulse-height analyzer	10–40	Radionuclide concentrations quantitated from gamma spectrometer data by computer using an eight element matrix technique	3.5	Generally 10 pCi/liter for most common fallout radionuclides in a simple spectrum.
Tritium	Automatic liquid scintillation counter with output printer	100	Sample prepared by distillation and counted in scintillation counter	.005	[b], [c] ≈320
Strontium-89, -90	Low background, thin-window, gas flow proportional counter with a 5.7 cm diameter window (80 μg/cm²)	50	Chemical separation by ion exchange. Separated sample counted sucessively; activity calculated by solution of simultaneous equations	1.0	[b] Strontium-89 ≈5 [b] Strontium-90 ≈2
Radium-226	Alpha scintillation counter	30	Chemical separation of radium, dissolve, and radon emanation procedure	1.5	[b] ≈.1
Gross alpha[d] Gross beta[d]	Low background, thin-window gas flow proportional counter with a 5.7 cm diameter window (80 μg/cm²)	50	Sample evaporated, residue counted	.2	[b] alpha ≈2 [b] beta ≈2

[a] On total liquid sample.
[b] The detection limit for a given sample is defined as that concentration which is equal to the 2-sigma counting error.
[c] The detection limit for samples analyzed during February and thereafter was ≈220 pCi/liter.
[d] On total solids of samples.

is conducted to determine radionuclide concentrations and to take protective action, if required.

Sampling in support of operations such as Project Rulison and the Cannikin Event is generally conducted in the same manner. Since the major sampling efforts for these projects were completed last year, only a few water samples are now being collected at selected locations on a reduced frequency. A description of the sampling programs and analytical results for these projects prior to January 1972 are reported separately (*1-3*).

Analytical procedures

All samples are analyzed by gamma spectroscopy and counted for gross alpha and gross beta radioactivity. In addition, samples from approximately 24 locations west, south, and southeast of NTS are routinely analyzed for tritium. Further analyses (strontium-89, -90, plutonium-238, -239, uranium, or tritium) on special samples are dependent upon whether activity related to the NTS is detected by gamma spectroscopy and/or special requirements of the sampling program.

Table 1 lists the general analytical procedures and detection limits, as described by Johns (*4*) and Lem and Snelling (*5*). For gamma spectroscopy analysis, the samples are placed in 3.5-liter inverted-well Marinelli beakers. All routine samples are counted 40 minutes. Special samples collected following known releases of activity are normally counted for 20 minutes, but this may vary from 10 to 40 minutes, depending upon radionuclide concentrations and total sample workload. The activity concentration of each of the detected nuclides at time of count is calculated and extrapolated to time of collection.

Results

The analytical results of all water samples collected in January, February, and March 1972 by NERC-LV surveillance programs are listed in table 2. Two samples each were collected in Alaska and Colorado in support of

Table 2. NERC-LV water surveillance results, January–March 1972

Location	Map	Date collected (1972)	Radioactivity concentration[a] (pCi/liter)			
			Sample type[b]	Gross alpha	Gross beta	Tritium
Alaska:						
Kodiak						
Dispensary		1/10	24	<1	6 ±3	<310
St. Paul:						
Kitchen tap		1/4	24	<3	<3	510 ±320
California:						
Bishop:						
Fish & Game Office	9	1/6	23	<2	4 ±3	NA
		2/10	23	<1	<3	NA
		3/6	23	<2	3 ±3	NA
Bishop:						
Owens River, 3 miles east	10	1/6	22	6 ±4	3 ±3	NA
		2/10	22	8 ±4	6 ±3	NA
		3/6	22	6 ±4	9 ±3	NA
Death Valley Jct:						
Lila's Cafe	21	1/5	23	<7	12 ±4	<320
		2/10	23	8 ±6	11 ±4	<260
		3/7	23	10 ±6	7 ±4	260 ±190
Furnace Creek:						
Visitors Center	29	1/6	27	<5	12 ±4	NA
		2/9	27	<4	11 ±4	NA
		3/7	27	<5	8 ±4	NA
Furnace Creek:						
Pond	28	1/6	21	6 ±5	11 ±4	NA
		2/9	21	<4	13 ±4	NA
		3/7	21	<4	14 ±4	NA
Hinkley:						
Bill Nelson Dairy	39	1/5	23	27 ±1	17 ±4	NA
		2/8	23	8 ±5	6 ±4	NA
		3/7	23	11 ±6	9 ±4	NA
Little Lake:						
Little Lake Ranch	60	1/6	21	14 ±8	26 ±5	NA
		2/8	21	21 ±9	21 ±5	NA
		3/7	21	15 ±8	31 ±5	NA
Lone Pine:						
Diaz Lake	61	1/6	21	18 ±8	27 ±4	NA
		2/8	21	27 ±9	31 ±5	NA
		3/17	21	33 ±10	25 ±5	NA
Forest Service Ranger Station	62	1/6	23	<2	<3	NA
		2/8	23	<2	<3	NA
		3/7	23	6 ±3	<3	NA
Olancha:						
Haiwee Reservoir	73	1/6	21	4 ±3	8 ±3	NA
		2/8	21	3 ±3	4 ±3	NA
		3/7	21	7 ±4	8 ±3	NA
Ridgecrest:						
City Hall	76	1/6	23	<4	4 ±3	NA
		2/8	23	5 ±4	3 ±3	NA
		3/7	23	4 ±3	<3	NA
Shoshone:						
Chevron Service Station	79	1/4	23	7 ±6	22 ±4	NA
		2/10	23	<5	18 ±4	NA
		3/7	23	<6	17 ±4	NA
Colorado:						
Grand Valley:						
Battlement Creek		1/22	22	NA	NA	620 ±340
Grand Valley:						
Battlement Creek above Test Well		1/22	22	NA	NA	550 ±330
Nevada:						
Adaven:						
Canfield Ranch	1	1/10	22	5 ±3	5 ±3	NA
		2/9	22	5 ±4	<3	NA
		3/8	22	4 ±3	5 ±3	NA
Alamo:						
Sheri's Bar	2	1/10	23	4 ±4	5 ±3	NA
		2/8	23	<3	<3	NA
		3/7	23	6 ±4	3 ±3	NA
Pahranagat Lake	3	1/10	21	25 ±9	25 ±4	NA
		2/8	21	23 ±8	21 ±4	NA
		3/7	21	12 ±6	18 ±4	NA
Wright Dairy	4	1/10	23	<5	12 ±4	NA
		2/8	23	5 ±4	10 ±4	NA
		3/7	23	<4	10 ±4	NA
Ash Meadows:						
Ash Meadows Lodge	5	NS	23			
		2/9	23	6 ±5	17 ±4	<280
		3/7	23	10 ±6	12 ±4	<200
Ash Meadows Pond	6	NS	21			
		2/9	21	14 ±7	19 ±4	NA
		3/7	21	15 ±8	22 ±5	NA

See footnotes at end of table.

Table 2. NERC-LV water surveillance results, January–March 1972—continued

Location	Map	Date collected (1972)	Radioactivity concentration[a] (pCi/liter)			
			Sample type[b]	Gross alpha	Gross beta	Tritium
Nevada—(continued)						
Austin:						
County Courthouse	7	1/12	27	30 ±7	17 ±4	NA
		2/9	27	22 ±6	21 ±4	NA
		3/8	27	21 ±6	18 ±4	NA
Beatty:						
Richfield Service Station	8	1/6	23	10 ±6	12 ±4	<310
		2/10	23	15 ±8	11 ±4	<290
		3/8	23	8 ±6	7 ±4	<220
Blue Diamond:						
Post Office	11	1/4	23	<4	3 ±3	<320
		2/10	23	<4	<3	<280
		3/6	23	<3	<3	300 ±250
Blue Jay Highway:						
Maintenance Station	12	1/11	23	4 ±3	7 ±3	NA
		2/10	23	6 ±4	6 ±3	NA
		3/8	23	<4	6 ±3	NA
Cactus Springs:						
Mobil Service Station	13	1/6	27	4 ±3	3 ±3	<320
		2/8	27	3 ±1	4 ±1	<310
		3/9	27	<2	<3	<220
Caliente:						
Agricultural Extension Station	14	1/11	23	7 ±4	7 ±3	NA
		2/10	23	5 ±4	6 ±3	NA
		3/8	23	6 ±4	4 ±3	NA
Meadow Valley wash	15	1/11	22	9 ±6	14 ±4	NA
		2/10	22	5 ±5	15 ±4	NA
		3/8	22	14 ±7	14 ±4	NA
Clark Station:						
Five Mile Ranch	17	NS	27			
		2/10	27	<3	6 ±3	NA
		3/9	27	<4	9 ±4	NA
Coyote Summit:						
Sand Spring well	18	NS	23			
		2/8	23	5 ±3	5 ±3	NA
		3/8	23	31 ±10	20 ±4	NA
Currant:						
Currant Pond	19	1/13	21	12 ±6	5 ±3	NA
		2/8	21	13 ±5	8 ±1	NA
		3/9	21	5 ±5	6 ±3	NA
Currant Ranch Cafe	20	1/13	27	10 ±5	9 ±4	NA
		2/8	27	14 ±6	10 ±4	NA
		3/8	27	8 ±5	5 ±3	NA
Diablo Highway:						
Maintenance Station	22	1/10	23	5 ±3	7 ±3	NA
		2/8	23	<3	7 ±3	NA
		3/7	23	<4	9 ±4	NA
Diablo:						
Reed Ranch	23	1/10	21	26 ±7	18 ±4	NA
		2/8	21	29 ±9	17 ±4	NA
		3/7	21	18 ±7	24 ±4	NA
Elgin:						
Water tower	24	1/12	23	5 ±5	9 ±3	NA
		2/9	23	9 ±5	11 ±4	NA
		NS	23			
Ely:						
Chevron Service Station	25	1/11	24	5 ±3	<3	NA
		2/9	24	4 ±3	<3	NA
		3/7	24	3 ±3	<3	NA
Comins Lake	26	NS	21			
		NS	21			
		3/7	21	3 ±3	5 ±3	NA
Eureka:						
Chevron Service Station	27	1/12	24	5 ±4	4 ±3	NA
		2/9	24	<3	3 ±3	NA
		3/8	24	5 ±3	5 ±3	NA
Glendale:						
Chevron Service Station	32	1/10	27	<5	11 ±4	NA
		2/8	27	9 ±6	13 ±4	NA
		3/7	27	7 ±5	10 ±4	NA
Muddy River	33	1/10	22	<6	16 ±4	NA
		2/8	22	7 ±6	13 ±4	NA
		3/7	22	5 ±5	14 ±4	NA
Goldfield:						
Alkali Springs	34	1/11	21	<8	26 ±5	NA
		2/8	21	<6	19 ±4	NA
		3/7	21	<7	24 ±5	NA
Chevron Service Station	35	1/10	23	<4	<3	NA
		2/8	23	5 ±4	3 ±3	NA
		3/7	23	<4	<3	NA
Hawthrone:						
Walker Lake[c]	36	NS	21			
		NS	21			
		3/7	21		130 ±21	NA

See footnotes at end of table.

Table 2. NERC-LV water surveillance results, January–March 1972—continued

Location	Map	Date collected (1972)	Radioactivity concentration[a] (pCi/liter)			
			Sample type[b]	Gross alpha	Gross beta	Tritium
Nevada—(continued)						
Hiko:						
Crystal Springs	37	1/10	27	7 ±4	8 ±3	NA
		2/8	27	8 ±4	6 ±4	NA
		3/7	27	14 ±5	10 ±7	NA
Schofield Dairy	38	1/10	23	23 ±8	30 ±5	NA
		2/8	23	24 ±8	37 ±5	NA
		3/7	23	38 ±10	21 ±4	NA
Indian Springs:						
Chevron Service Station	40	1/6	23	5 ±4	<3	<310
		2/8	23	5 ±3	<3	<280
		3/9	23	2 ±2	<3	<220
Las Vegas:						
Cal-Nev Jet Fuels	41	1/3	23	4 ±3	6 ±3	<290
		2/15	23	<3	4 ±3	230
		NS	23			
Craig Ranch golf course	42	1/3	23	5 ±3	10 ±4	<290
		2/15	23	10 ±5	5 ±3	<230
		NS	23			
Cunningham Ranch	43	1/3	23	<3	<3	<290
		2/15	23	<3	<3	<210
		NS	23			
Desert Game Range	44	1/6	23	6 ±4	7 ±3	<310
		2/8	23	15 ±5	4 ±3	<310
		3/9	23	22 ±6	14 ±4	400 ±250
Desert Game Range Pond	45	1/6	21	<3	4 ±3	<310
		2/8	21	5 ±3	3 ±3	<280
		3/9	21	4 ±3	<3	<200
Francis residence	46	1/3	23	<5	5 ±3	<290
		2/15	23	6 ±5	<3	<190
		NS	23			
Lab II, NERC-LV	47	1/3	24	6 ±5	7 ±3	1100 ±310
		2/15	24	<5	5 ±4	870 ±240
		NS	24			
Lake Mead, Vegas Wash	48	1/3	21	<5	9 ±4	1400 ±310
		2/15	21	<5	7 ±4	760 ±220
		NS	21			
LDS dairy farm	49	1/4	23	<7	12 ±4	<280
		2/16	23	<8	18 ±5	<210
		NS	23			
Las Vegas:						
Lloyd Ranch	50	1/3	23	6 ±5	6 ±3	360 ±290
		2/15	23	<5	7 ±4	<190
		NS	23			
L V Water District well 28	51	1/3	23	4 ±3	4 ±3	<290
		2/15	23	4 ±3	<3	<230
		NS	23			
Municipal golf course	52	1/3	23	4 ±3	4 ±3	<290
		2/15	23	<3	<3	<230
		NS	23			
Tule Springs	53	1/6	23	10 ±4	9 ±3	<340
		2/8	23	6 ±3	<3	<290
		3/9	23	3 ±2	<3	<250
Tule Springs Pond	54	1/6	21	4 ±3	6 ±3	NA
		2/8	21	10 ±4	6 ±3	NA
		3/9	21	6 ±3	4 ±3	NA
Vegas Estates	55	1/3	23	<6	13 ±4	<290
		2/16	23	<6	12 ±4	<210
		NS	23			
Lathrop Wells:						
Texaco Service Station	56	1/5	23	<4	4 ±3	<320
		2/8	23	7 ±4	12 ±4	290
		3/8	23	4 ±3	5 ±3	230 ±220
Lida Junction:						
Cottontail Ranch	57	NS	23			
		2/8	23	17 ±7	13 ±4	NA
		3/6	23	9 ±6	16 ±4	NA
Lida:						
Lida Livestock Company	58	1/10	27	4 ±3	<3	NA
		2/8	27	<3	<3	NA
		3/16	27	<3	<3	NA
Pond at storage tank	59	1/10	21	3 ±3	<3	NA
		2/8	21	<3	3 ±3	NA
		3/6	21	5 ±4	6 ±3	NA
Lund:						
Gardner grocery	63	1/11	23	6 ±3	10 ±4	NA
		2/9	23	5 ±3	<3	NA
		3/9	23	5 ±3	<3	NA
Manhattan:						
Country store	64	1/12	27	26 ±8	9 ±4	NA
		2/9	27	16 ±7	10 ±4	NA
		3/8	27	20 ±7	6 ±3	NA
Seyler Reservoir	65	1/12	21	8 ±5	13 ±4	NA
		2/9	21	<3	6 ±3	NA
		3/8	21	22 ±8	36 ±5	NA

See footnote at end of table.

Table 2. NERC-LV water surveillance results, January–March 1972—continued

Location	Map	Date collected (1972)	Radioactivity concentration[a] (pCi/liter)			
			Sample type[b]	Gross alpha	Gross beta	Tritium
Nevada—(continued)						
Mercury:						
Groom Lake	66	1/10	23	4 ±3	7 ±3	NA
		2/8	23	4 ±3	<4	NA
		3/7	23	<4	6 ±3	NA
Moapa:						
Pedersen Valley View Ranch	67	1/10	27	6 ±5	13 ±4	NA
		2/8	27	7 ±5	10 ±4	NA
		3/7	27	6 ±4	7 ±3	NA
Mt. Charleston:						
Kyle Canyon	68	NS	27			
		2/8	27	<2	<3	320 ±310
		3/9	27	<2	<3	380 ±220
Kyle Canyon Pond	69	NS	21			
		NS	21			
		NS	21			
Nyala:						
Sharp's Ranch	72	1/11	23	4 ±3	<3	NA
		2/10	23	3 ±3	<3	NA
		3/8	23	<3	4 ±3	NA
Pahrump:						
Texaco Service Station	74	1/4	23	5 ±4	5 ±3	NA
		2/10	23	<3	<3	NA
		3/6	23	4 ±3	<3	NA
Pioche:						
Country Courthouse	75	1/11	24	3 ±3	11 ±4	NA
		2/9	24	4 ±3	4 ±4	NA
		3/8	24	3 ±3	7 ±3	NA
Round Mt:						
Mobil Service Station	77	1/12	27	<3	4 ±3	NA
		2/9	27	3 ±2	4 ±3	NA
		3/8	27	3 ±2	<3	NA
Scotty's Junction:						
Chevron Service Station	78	1/13	23	<6	12 ±4	<290
		2/8	23	<5	13 ±4	<250
		3/6	23	<4	10 ±4	<200
Springdale:						
Peacock Ranch	80	1/5	27	<5	11 ±4	<310
		2/10	27	<4	11 ±4	<280
		3/8	27	<4	7 ±3	<220
Pond	81	1/5	21	<6	13 ±4	NA
		2/10	21	5 ±5	13 ±4	NA
		3/8	21	4 ±4	12 ±4	NA
Sunnyside:						
Adam McGill Reservoir	83	1/11	21	7 ±5	8 ±3	NA
		2/9	21	15 ±6	8 ±4	NA
		3/9	21	7 ±4	8 ±3	NA
Wildlife Mgt Headquarters	84	1/11	27	<3	<3	NA
		2/9	27	3 ±2	5 ±3	NA
		3/8	27	<3	4 ±3	NA
Tonopah:						
Jerry's Chevron Station	85	1/11	23	<3	5 ±3	NA
		2/8	23	<3	7 ±4	NA
		3/8	23	4 ±3	7 ±3	NA
Tonopah Test Range CP-1	86	1/11	23	10 ±5	10 ±4	NA
		2/10	23	6 ±5	5 ±3	NA
		3/9	23	6 ±4	5 ±3	NA
Warm Springs:						
Fallini's Pond	87	NS	21			NA
		2/8	21	20 ±9	48 ±6	NA
		3/7	21	12 ±8	43 ±5	NA
Hot Creek Ranch	88	1/12	27	6 ±5	16 ±4	NA
		2/8	27	<5	10 ±4	NA
		3/8	27	<6	12 ±4	NA
Service station and Cafe	89	NS	27			NA
		NS	27			
		3/9	27	11 ±7	21 ±4	NA
Twin Springs Ranch	90	1/11	23	13 ±6	16 ±4	NA
		2/10	23	5 ±4	9 ±4	NA
		3/8	23	6 ±5	10 ±4	NA
Utah:						
Cedar City:						
M. D. Baldwin Reservoir	16	1/11	24	<3	<3	NA
		2/8	24	<3	<3	NA
		3/14	24	<3	3 ±3	NA
Garrison:						
Pruess Reservoir[c]	30	NS	21			
		NS	21			
		3/7	21	15 ±7	14 ±4	NA
Rowley grocery	31	1/12	23	3 ±3	4 ±3	NA
		2/10	23	4 ±3	<3	NA
		3/7	23	<4	<3	NA

See footnotes at end of table.

Table 2. NERC-LV water surveillance results, January–March 1972—continued

Location	Map	Date collected (1972)	Radioactivity concentration[a] (pCi/liter)			
			Sample type[b]	Gross alpha	Gross beta	Tritium
Utah—(continued						
Newcastle:						
Newcastle dairy	71	1/11	24	3 ±2	4 ±3	NA
		2/9	24	7 ±5	8 ±4	NA
		3/15	24	<5	8 ±3	NA
Municipal Reservoir	70	1/11	21	<3	<3	NA
		2/9	21	4 ±3	8 ±4	NA
		3/14	21	10 ±6	10 ±4	NA
St. George:						
R. Cox dairy	82	1/10	24	8 ±5	8 ±3	NA
		2/8	24	4 ±2	<3	NA
		3/14	24	<3	4 ±3	NA

[a] Two-sigma counting error provided when available.
[b] 21—Pond, lake, reservoir, stock tank, stock pond.
22—Stream, river, creek.
23—Well
24—Multiple supply—mixed water sample consisting of mixed or multiple sources of water, such as well or spring.
27—Spring
[c] Quarterly samples.
NA, not analyzed.
NS, no sample

the Cannikin Event and Project Rulison, respectively. All other samples listed in table 2 were collected from the Water Surveillance Network. No gamma-emitting fission products were detected in any of the samples.

Copies of these results are distributed to EPA Regional Offices and appropriate State agencies prior to publication.

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SECTION III. AIR AND DEPOSITION

Radioactivity in Airborne Particulates and Precipitation

Continuous surveillance of radioactivity in air and precipitation provides one of the earliest indications of changes in environmental fission product radioactivity. To date, this surveillance has been confined chiefly to gross beta radioanalysis. Although such data are insufficient to assess total human radiation exposure from fallout, they can be used to determine when to modify monitoring in other phases of the environment.

Surveillance data from a number of programs are published monthly and summarized periodically to show current and long-range trends of atmospheric radioactivity in the Western Hemisphere. These include data from activities of the Environmental Protection Agency, the Canadian Department of National Health and Welfare, the Mexican National Institute of Nuclear Energy, and the Pan American Health Organization.

In addition to those programs presented in this issue, the following programs were previously covered in *Radiation Data and Reports.*

Network	Period	Issue
Fallout in the United States and other areas, *HASL*	January–December 1970	December 1971
Mexican Air Monitoring Program	January–April 1972	September 1972
Plutonium in Airborne Particulates	October–December 1971	July 1972
Surface Air Sampling Program; 80th Meridian Network, *HASL*	January–December 1969	February 1972

1. Radiation Alert Network August 1972

Division of Atmospheric Surveillance
Environmental Protection Agency

Surveillance of atmospheric radioactivity in the United States is conducted by the Radiation Alert Network (RAN) which regularly gathers samples at 70 locations distributed throughout the country (figure 1). Most of the stations are operated by State health department personnel.

The station operators perform "field estimates" on the airborne particulate samples at 5 hours after collection, when most of the radon daughter products have decayed, and at 29 hours after collection, when most of the thoron daughter products have decayed. They also perform field estimates on dried precipitation samples and report all results to appropriate Environmental Protection Agency officials by mail or telephone depending on levels found. A compilation of the daily field estimates is available upon request from the Air Quality Information Systems Branch, Division of Atmospheric Surveillance, EPA, Research Triangle Park, N.C. 27711. A detailed description of the sampling and analytical procedures was presented in the March 1968 issue of *Radiological Health Data and Reports.*

Table 1 presents the monthly average gross beta radioactivity in surface air particulates and deposition by precipitation, as measured by the field estimate technique, during August 1972.

All other field techniques reported were within normal limits for the reporting station.

Figure 1. Radiation Alert Network sampling stations

Table 1. Gross beta radioactivity in surface air and precipitation, August 1972

Station location		Number of samples	Gross beta radioactivity (5-hour field estimate) (pCi/m³)			Number of samples	Total depth (mm)	Precipitation		
			Maximum	Minimum	Average[a]			Field estimation of deposition		
								Number of samples	Depth (mm)	Total deposition (nCi/m²)
Ala:	Montgomery	16	2	1	1	1	16	1	16	2
Alaska:	Anchorage	2	0	0	0	0				
	Attu Island	30	1	0	0	0				
	Fairbanks	0				0				
	Juneau	0				0				
	Nome	0				0				
	Point Barrow	0				0				
Ariz:	Phoenix	16	6	1	3	0				
Ark:	Little Rock	16	3	0	1	0				
Calif:	Berkeley	17	0	0	0	0				
	Los Angeles	13	2	0	1	0				
C.Z:	Ancon	15	0	0	0	0				
Colo:	Denver	13	6	1	2	3	83	[b]		
Conn:	Hartford	16	1	0	1	4	31	4	31	0
Del:	Dover	12	1	0	1	0				
D.C:	Washington	17	1	0	0	0				
Fla:	Jacksonville	15	1	0	0	8	143	7	116	2
	Miami	0				0				
Ga:	Atlanta	23	4	1	1	0				
Guam:	Agana	0				0				
Hawaii:	Honolulu	18	1	0	0	1	10	[b]		
Idaho:	Boise	19	2	0	1	0				
Ill:	Springfield	6	2	1	1	0				
Ind:	Indianapolis	16	2	0	1	0				
Iowa:	Iowa City	14	3	0	1	6	164	6	164	2
Kans:	Topeka	17	6	1	2	6	79	5	77	7
Ky:	Frankfort	0				0				
La:	New Orleans	13	0	0	0	5	27	[b]		
Maine:	Augusta	12	2	0	1	3	36	3	36	0
Md:	Baltimore	15	2	0	1	4	26	4	26	19
Mass:	Lawrence	15	1	0	1	2	39	2	39	0
	Winchester	12	3	0	1	2	20	2	20	0
Mich:	Lansing	16	1	0	0	10	86	10	86	12
Minn:	Minneapolis	15	2	0	1	5	50	5	50	7
Miss:	Jackson	12	3	0	1	1	15	1	15	0
Mo:	Jefferson City	15	5	0	2	6	35	6	35	0
Mont:	Helena	16	3	1	1	3	23	3	23	0
Nebr:	Lincoln	12	8	0	3	2	69	2	69	14
Nev:	Las Vegas	16	3	1	2	0				
N.H:	Concord	0				0				
N.J:	Trenton	17	2	0	1	2	46	2	46	2
N. Mex:	Santa Fe	12	2	0	1	1	21	1	21	0
N.Y:	Albany	0				0				
	Buffalo	21	1	0	1	0				
	New York City	0				0				
N.C:	Gastonia	14	10	1	4	0				
N. Dak:	Bismarck	19	4	0	2	5	37	5	37	12
Ohio:	Cincinnati	0				0				
	Columbus	3	1	0	1	0				
	Painesville	11	1	0	1	4	41	4	41	8
Okla:	Oklahoma City	10	6	0	2	0				
	Ponca City	16	7	1	2	8	83	8	83	0
Oreg:	Portland	13	1	0	0	0				
Pa:	Harrisburg	7	2	0	1	1	20	1	20	4
P.R:	San Juan	0				0				
R.I:	Providence	16	2	0	1	0				
S.C:	Columbia	14	2	0	1	3	94	3	94	0
S. Dak:	Pierre	16	5	2	3	0				
Tenn:	Nashville	18	2	0	1	5	107	5	107	2
Tex:	Austin	17	4	1	3	2	28	[b]		
	El Paso	16	4	0	1	0				
Utah:	Salt Lake City	19	2	1	1	0				
Vt:	Barre	16	5	1	2	6	38	6	38	5
Va:	Richmond	9	1	0	0	0				
Wash:	Seattle	5	0	0	0	1	6	[b]		
	Spokane	18	2	0	1	0				
W. Va:	Charleston	15	3	0	1	4	49	4	49	6
Wisc:	Madison	14	2	0	0	4	100	4	100	3
Wyo:	Cheyenne	15	10	2	5	0				
Network summary		831	10	0	1	118	62	4	55	4

[a] The monthly average is calculated by weighting the field estimates of individual air samples with length of sampling period.
[b] This station is part of the tritium surveillance system. No gross beta measurements are done.

2. Canadian Air and Precipitation Monitoring Program,[1] August 1972

Radiation Protection Division
Department of National Health and Welfare

The Radiation Protection Division of the Canadian Department of National Health and Welfare monitors surface air and precipitation in connection with its Radioactive Fallout Study Program. Twenty-four collection stations are located at airports (figure 2), where the sampling equipment is operated by personnel from the Meteorological Services Branch of the Department of Transport. Detailed discussions of the sampling procedures, methods of analysis, and interpretation of results of the radioactive fallout program are contained in reports of the Department of National Health and Welfare (*1-5*).

A summary of the sampling procedures and methods of analysis was presented in the May 1969 issue of *Radiological Health Data and Reports.*

Surface air and precipitation data for August 1972 are presented in table 2.

[1] Prepared from information and data obtained from the Canadian Department of National Health and Welfare, Ottawa, Canada.

Table 2. Canadian gross beta radioactivity in surface air and precipitation, August 1972

Station	Number of samples	Air surveillance gross beta radioactivity (pCi/m³)			Precipitation measurements	
		Maximum	Minimum	Average	Average concentration (pCi/liter)	Total deposition (nCi/m²)
Calgary	4	0.1	0.0	0.1	22	1.3
Coral Harbour	4	.0	.0	.0	56	.1
Edmonton	4	.1	.1	.1	43	3.0
Ft. Churchill	3	.1	.0	.0	30	2.7
Fredericton	4	.0	.0	.0	23	2.2
Goose Bay	4	.0	.0	.0	17	2.3
Halifax	9	.1	.0	.1	26	1.9
Inuvik	4	.0	.0	.0	37	2.0
Montreal	4	.1	.0	.0	19	2.4
Moosonee	4	.1	.0	.1	23	1.8
Ottawa	4	.1	.0	.1	25	3.5
Quebec	4	.1	.0	.1	18	3.2
Regina	4	.1	.0	.1	26	1.1
Resolute	4	.0	.0	.0	16	.4
St. John's, Nfld	4	.0	.0	.0	11	1.3
Saskatoon	4	.1	.0	.1	50	1.6
Sault Ste. Marie	NS				50	4.9
Thunder Bay	4	.1	.1	.1	51	2.1
Toronto	4	.0	.0	.0	21	2.6
Vancouver	4	.0	.0	.0	51	1.2
Whitehorse	4	.1	.0	.0	41	1.8
Windsor	4	.1	.0	.1	23	3.0
Winnipeg	4	.1	.0	.0	15	1.6
Yellowknife	4	.0	.0	.0	44	1.4
Network summary	96	0.1	0.0	0.0	31	2.1

NS, no sample.

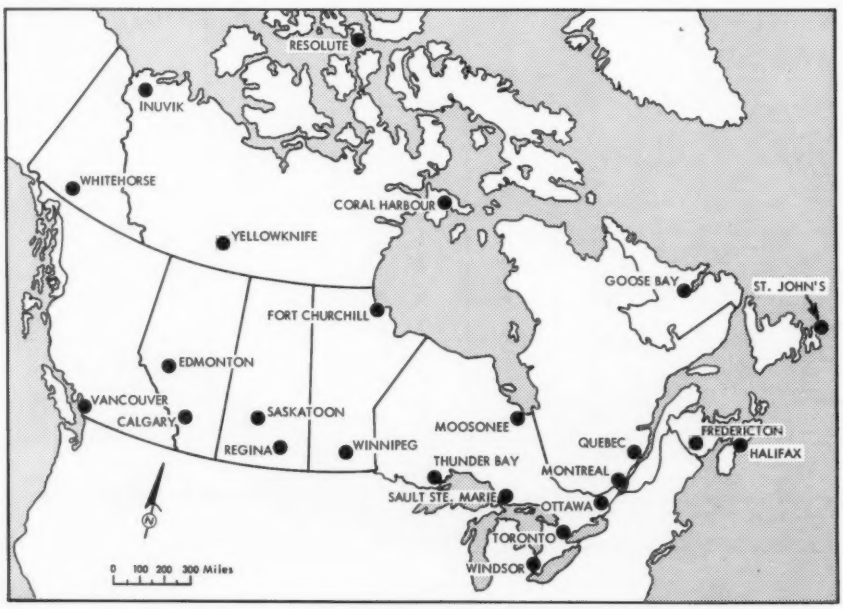

Figure 2. Canadian air and precipitation monitoring program

3. Pan American Air Sampling Program August 1972

Pan American Health Organization and U.S. Environmental Protection Agency

Gross beta radioactivity in air is monitored by countries in the Americas under the auspices of the collaborative program developed by the Pan American Health Organization (PAHO) and the Environmental Protection Agency (EPA) to assist PAHO-member countries in developing radiological health programs.

The air sampling station locations are shown in figure 3. Analytical techniques were described in the March 1968 issue of *Radiological Health Data and Reports*. The August 1972 air monitoring results from the participating countries are given in table 3.

Table 3. Summary of gross beta radioactivity in Pan American surface air, August 1972

Station location		Number of samples	Gross beta radioactivity (pCi/m³)		
			Maximum	Minimum	Average[a]
Argentina:	Burenos Aires	0			
Bolivia:	La Paz	0			
Chile:	Santiago	30	1.43	0.02	0.18
Colombia:	Bogota	12	0.05	.00	.02
Ecuador:	Cuenca	0			
	Guayaquil	21	3.90	.03	.45
	Quito	21	.05	.00	.01
Guyana:	Georgetown	0			
Jamaica:	Kingston	0			
Peru:	Lima	0			
Venezuela:	Caracas	8	.03	.01	.02
West Indies:	Trinidad	0			
Pan American summary		92	3.90	0.00	0.17

[a] The monthly average is calculated by weighting the individual samples with length of sampling period. Values less than 0.005 pCi/m³ are reported and used in averaging as 0.00 pCi/m³.

Figure 3. Pan American Air Sampling Program stations

4. California Air Sampling Program August 1972

Bureau of Radiological Health
California State Department of Public Health

The Bureau of Radiological Health of the California State Department of Public Health with the assistance of several cooperating agencies and organizations operates a surveillance system for determining radioactivity in airborne particulates. The air sampling locations are shown in figure 4.

All air samples are sent to the Sanitation and Radiation Laboratory of the State Department of Public Health where they are analyzed for their radioactive content.

Figure 4. California air sampling program stations

Airborne particles are collected by a continuous sampling of air filtered through a 47 millimeter membrane filter, 0.8 micron pore size, using a Gast air pump of about 2-cubic feet per minute capacity, or 81.5 cubic meters per day. All volumes are measured with a direct reading gas meter. Filters are replaced every 24 hours except on holidays and weekends. The filters are analyzed for gross alpha and beta radioactivity 72 hours after the end of the collection period. The daily samples are then composited into a monthly sample for gamma spectroscopy and an analysis for strontium-89 and strontium-90. Table 4 presents the monthly gross beta radioactivity in air for August 1972. The monthly sample results are presented quarterly.

Table 4. Gross beta radioactivity in California air August 1972

Station location	Number of samples	Gross beta radioactivity (pCi/m³)		
		Maximum	Minimum	Average
Bakersfield	31	0.99	0.09	0.30
Barstow	31	.74	.09	.25
Berkeley	31	.12	.00	.06
Colfax	31	.33	.03	.19
El Centro	31	2.15	.03	.28
Eureka	31	.14	.00	.05
Fresno	31	1.73	.05	.25
Los Angeles	31	.29	.07	.13
Redding	30	1.02	.08	.28
Sacramento	31	.62	.05	.18
Salinas	31	1.36	.09	.25
San Bernardino	29	.96	.11	.27
San Diego	31	.35	.08	.13
Santa Rosa	28	.26	.00	.10
Summary	428	2.15	0.00	0.19

5. Plutonium in Airborne Particulates January–March 1972

Office of Radiation Programs
Environmental Protection Agency

The Radiation Alert Network (RAN) of the Division of Atmospheric Surveillance, Environmental Protection Agency, routinely collects airborne particulate samples from 11 selected RAN stations for plutonium analyses. The plutonium analyses were initiated in November 1965, and references to the previous results through December 1969 have been published (*6*).

One-half of each individual air filter from the selected stations is sent to the Eastern Environmental Radiation Laboratory, Montgomery, Ala. The laboratory analyzes a composite of these samples from each station on a quarterly basis. The results from January–March 1972 are presented in table 5. The minimum detectable activities are 0.020 pCi and 0.015 pCi per sample for plutonium-238 and plutonium-239, respectively. The volume of air samples varies, generally ranging from 20,000 to 30,000 cubic meters per month.

Table 5. Plutonium in airborne particulates January–March 1972

Location	Plutonium-238 (aCi/m³)	Plutonium-239 (aCi/m³)	Plutonium-239/ plutonium-238
Alaska: Anchorage	5±3	27±11	5±4
Ariz: Phoenix	12±4	61±15	5±2
Colo: Denver	15±5	61±16	4±2
Hawaii: Honolulu	2±1	19±4	10±5
La: New Orleans	2±1	30±7	15±8
Md: Baltimore	5±2	21±6	4±2
N.Y: Buffalo	2±1	18±5	9±5
N.C: Gastonia	3±2	38±11	13±9
S. Dak: Pierre	3±1	21±5	7±3
Tex: Austin	3±1	38±8	12±5
Wash: Seattle	4±2	19±4	4±3

Other coverage in *Radiation Data and Reports:*

Period	Issue
January–March 1971	November 1971
April–June 1971	March 1972
July–September 1971	April 1972
October–December 1971	July 1972

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Air Surveillance Network, August 1972

National Environmental Research Center—Las Vegas,[1] Environmental Protection Agency

The Air Surveillance Network (ASN), operated by the National Environmental Research Center (NERC-LV), consists of 104 active and 18 standby sampling stations located in 21 western States (figures 1 and 2). The network is operated in support of nuclear testing sponsored by the Atomic Energy Commission (AEC) at the Nevada Test Site (NTS), by the Space Nuclear Systems Office at the Nuclear Rocket Development Station which lies within the NTS, and by the AEC at any other designated testing sites.[2]

[1] Formerly the Western Environmental Research Laboratory.

[2] The ASN is operated under a Memorandum of Understanding (No. AT(26–1)–539) with the Nevada Operations Office, U.S. Atomic Energy Commission.

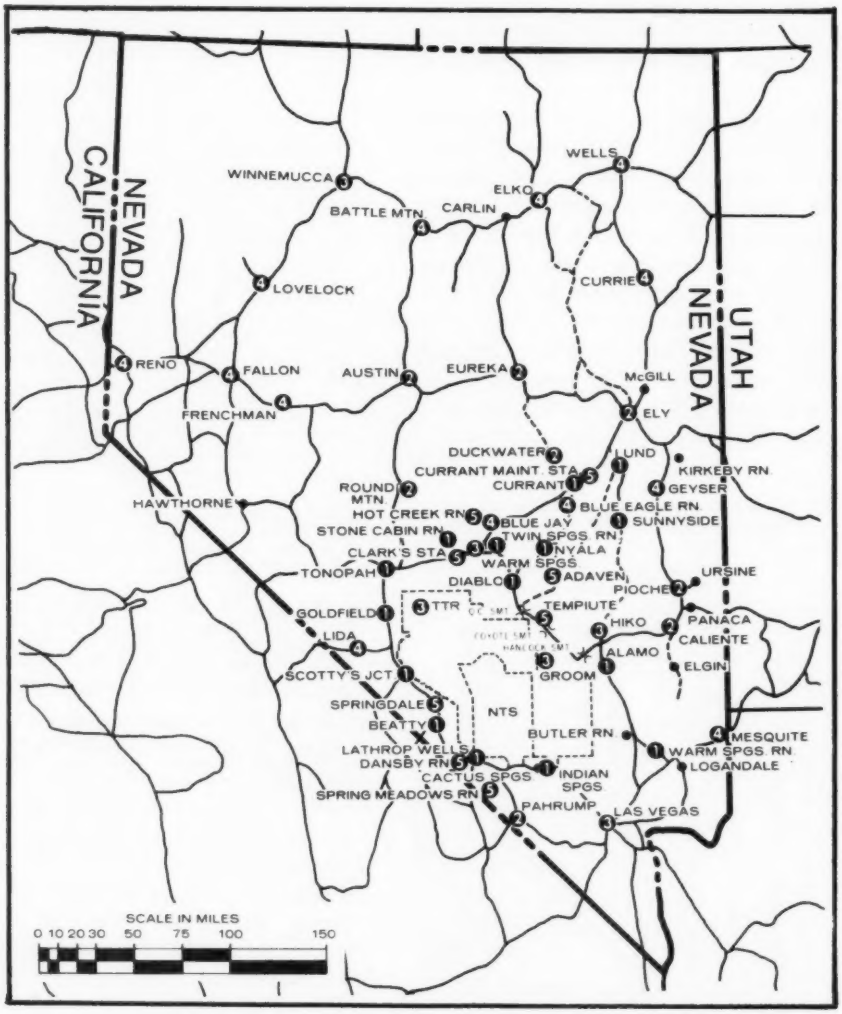

Figure 1. NERC-LV Air Surveillance Network stations in Nevada

Figure 2. NERC-LV Air Surveillance Network stations outside Nevada

The stations are operated by State health department personnel and by private individuals on a contract basis. Daily 24-hour samples are collected at each station. All samples are mailed to the NERC-LV unless special retrieval is arranged at selected locations in support of known releases of radioactivity from the NTS. A complete description of sampling and analytical procedures was presented in the February 1972 issue of *Radiation Data and Reports*.

Copies of this summary and listings of the daily gross beta and gamma spectrometry results are distributed to EPA regional offices and appropriate State agencies. Additional copies of the daily results may be obtained from the NERC-LV upon written request.

Results

Table 1 presents the monthly average gross beta radioactivity in air particulates for each of the network stations. The minimum reported concentration for gross beta is 0.1 pCi/m^3; however, gross beta concentrations above the minimum detectable concentration of 0.06 pCi/m^3 are used in determining averages. Individual concentrations which are below the minimum detectable concentration are assumed to be equal to the minimum detectable concentration. Averages less than the minimum reported level are reported as $<$0.1 pCi/m^3. The highest gross beta concentration within the network on a single filter during August was 1.3 pCi/m^3 at Monticello, Utah.

No radionuclides were identified by gamma spectrometry on any filters or charcoal cartridges during August.

Complete copies of this summary and listings of the daily gross beta and gamma spcetrometry results are distributed to EPA regional offices and appropriate State agencies. Additional copies of the daily results may be obtained from the NERC-LV upon written request.

Table 1. Summary of gross beta radioactivity concentrations in air, August 1972

Location		Number of samples	Concentration (pCi/m³)		
			Maximum	Minimum	Average [a]
Ariz:	Kingman	31	0.2	<0.1	0.1
	Phoenix	31	.2	<.1	.1
	Seligman	31	.2	<.1	.1
	Winslow	29	.2	<.1	.1
Ark:	Little Rock	23	.2	<.1	.1
Calif:	Baker	30	.2	<.1	.1
	Barstow	31	.2	<.1	.1
	Bishop	30	.2	<.1	.1
	Death Valley Junction	29	.3	<.1	.2
	Furnace Creek	31	.2	<.1	.1
	Indio	31	.3	<.1	.1
	Lone Pine	31	.7	<.1	.2
	Needles	21	.2	<.1	.1
	Ridgecrest	22	.2	<.1	.1
	Shoshone	28	.3	<.1	.1
Colo:	Denver	22	.7	<.1	.1
	Durango	31	.2	<.1	.1
Idaho:	Boise	31	.3	<.1	.2
	Idaho Falls	23	.4	<.1	.1
	Preston	30	.3	<.1	.1
	Twin Falls	31	.3	<.1	.1
Iowa:	Iowa City	23	.2	<.1	.1
	Sioux City	16	.2	<.1	.1
Kans:	Dodge City	31	.2	<.1	.1
La:	Lake Charles	21	.2	<.1	.1
	Monroe	24	.3	<.1	.1
	New Orleans	22	.2	<.1	.1
Minn:	Minneapolis	22	.2	<.1	.1
Mo:	Joplin	25	.2	<.1	.1
	St. Joseph	31	.5	<.1	.1
	St. Louis	31	.3	<.1	.1
Nebr:	North Platte	28	.2	<.1	.1
Nev:	Alamo	30	<.4	<.1	.1
	Austin	23	.2	<.1	.1
	Battle Mountain	31	.2	<.1	.1
	Beatty	31	.4	<.1	.1
	Blue Eagle Ranch (Currant)	28	.3	<.1	.1
	Blue Jay	31	.3	<.1	.1
	Caliente	30	.4	<.1	.1
	Currant Ranch	31	.3	<.1	.1
	Currie	31	.2	<.1	.1
	Diablo	31	.7	<.1	.1
	Duckwater	22	.3	<.1	.1
	Elko	31	.4	<.1	.2
	Ely	30	.2	<.1	.1
	Eureka	31	.3	<.1	.1
	Fallini's Twin Springs Ranch	17	.3	<.1	.2
	Fallon	31	.3	<.1	.2
	Frenchman station	31	.4	<.1	.2
	Geyser maintenance station	29	.7	<.1	.1
	Goldfield	30	.3	<.1	.1
	Groom Lake	30	.2	<.1	.1
	Hiko	31	.3	<.1	.1
	Indian Springs	26	.2	<.1	.1
Nev:	Las Vegas	22	.3	<.1	.1
	Lathrop Wells	30	.2	<.1	.1
	Lida	31	.3	<.1	.1
	Lovelock	31	.3	<.1	.2
	Lund	31	.2	<.1	.1
	Mesquite	31	.2	<.1	.1
	Nyala	31	.4	<.1	.2
	Pahrump	17	.2	<.1	.1
	Ploche	29	.3	<.1	.1
	Reno	31	.4	<.1	.1
	Round Mountain	31	.2	<.1	.1
	Scotty's Junction	27	.3	<.1	.1
	Stone Cabin Ranch	31	.2	<.1	.1
	Sunnyside	25	.3	<.1	.1
	Tonopah	31	.2	<.1	.1
	Tonopah Test Range	20	.2	<.1	.1
	Warm Springs	30	.2	<.1	.1
	Warm Springs Ranch	31	.2	<.1	.1
	Wells	31	.3	<.1	.1
	Winnemucca	31	.3	<.1	.2
N. Mex:	Albuquerque	22	.2	<.1	.1
	Carlsbad	29	.1	<.1	.1
Okla:	Muskogee	31	.2	<.1	.1
Oreg:	Burns	30	.5	<.1	.1
	Medford	30	.7	<.1	.1
S. Dak:	Aberdeen	31	.3	<.1	.1
	Rapid City	31	.3	<.1	.1
Tex:	Abilene	28	.2	<.1	.1
	Amarillo	31	.2	<.1	.1
	Austin	23	.2	<.1	.1
	Fort Worth	29	.3	<.1	.1

See footnote at end of table.

Table 1. Summary of gross beta radioactivity concentrations in air, August 1972—continued

Location		Number of samples	Concentration (pCi/m³)		
			Maximum	Minimum	Average [a]
Utah:	Bryce Canyon	24	.2	<.1	.1
	Cedar City	28	1.2	<.1	.2
	Delta	29	.2	<.1	.1
	Dugway	31	.3	<.1	.1
	Enterprise	31	.3	<.1	.1
	Garrison	31	.3	<.1	.1
	Logan	30	1.0	<.1	.2
	Milford	30	.6	<.1	.1
	Monticello	3	1.3	.2	.4
	Parowan	27	.2	<.1	.1
	Provo	31	.5	<.1	.1
	Roosevelt	29	.3	<.1	.1
	Salt Lake City	31	.1	<.1	.1
	St. George	31	.3	<.1	.1
	Wendover	30	.3	<.1	.1
Wash:	Seattle	26	.2	<.1	.1
	Spokane	23	.3	<.1	.1
Wyo:	Rock Springs	31	.3	<.1	.1
	Worland	31	.2	<.1	.1

[a] Individual values less than the minimum detectable concentration (MDC) are set equal to the MDC for averaging. A monthly average less than the minimum reportable value of 0.1 pCi/m³ is reported as <0.1.

SECTION IV. OTHER DATA

This section presents results from routine sampling of biological materials and other media not reported in the previous sections. Included here are such data as those obtained from human bone sampling, Alaskan surveillance, and enviromental monitoring around nuclear facilities.

Radiological Surveillance Around the Florida Power Corporation's Crystal River Power Reactor Site, 1971

Florida Division of Health

Since May 1969, radiological surveillance has been conducted around the Crystal River power reactor site of the Florida Power Corporation by the Florida Division of Health. Activities at this site include a 387 MW(e) coal-fired generating unit and a 510 MW(e) coal-fired generating unit with construction of unit three underway (this unit is to be an 855 MW(e) nuclear power generating plant). A description of the site and the sampling and analysis procedures used was presented in the September 1971 issue of *Radiological Health Data and Reports*. Sampling site locations are shown in figure 1.

Ninety-five samples of the environmental media shown in table 1 were collected.

During 1971, 95 air particulate samples were collected from five sampling locations (C 04, C 07, C 08, C 18, C 26). All levels of gross beta-gamma radioactivity were less than the minimum detectable level (1 pCi/m^3).

Table 2 presents the radioactivity found in samples of vegetation. The results of special vegetation samples and food crop samples are presented in table 3. The oranges were taken from a citrus grove located about 7.5 miles from the plant. Saw palmetto and its berries constitute an element in the diet of deer, and deer meat is in the direct human food chain.

Table 4 presents the radionuclide concentrations that were found in samples of marine biota. Concentrations of radioactivity found in

Table 1. Environmental samples collected at Crystal River, 1971

Vector	Number of samples collected in 1971				
	Jan–Mar	Apr–June	July–Sept	Oct–Dec	Total
Air particulates	5	29	22	40	95
Vegetation	29	30	30	32	121
Food crop	1	0	0	1	2
Milk	1	0	1	0	2
Soil	10	0	10	0	20
Silt	4	5	4	4	17
Marine biota	8	6	2	8	24
Seawater	6	5	7	5	23
Surface water	3	4	3	4	14
Drinking water	6	6	6	6	24
Precipitation	14	12	28	2	56
Thermoluminescent dosimeters	0	15	15	15	45

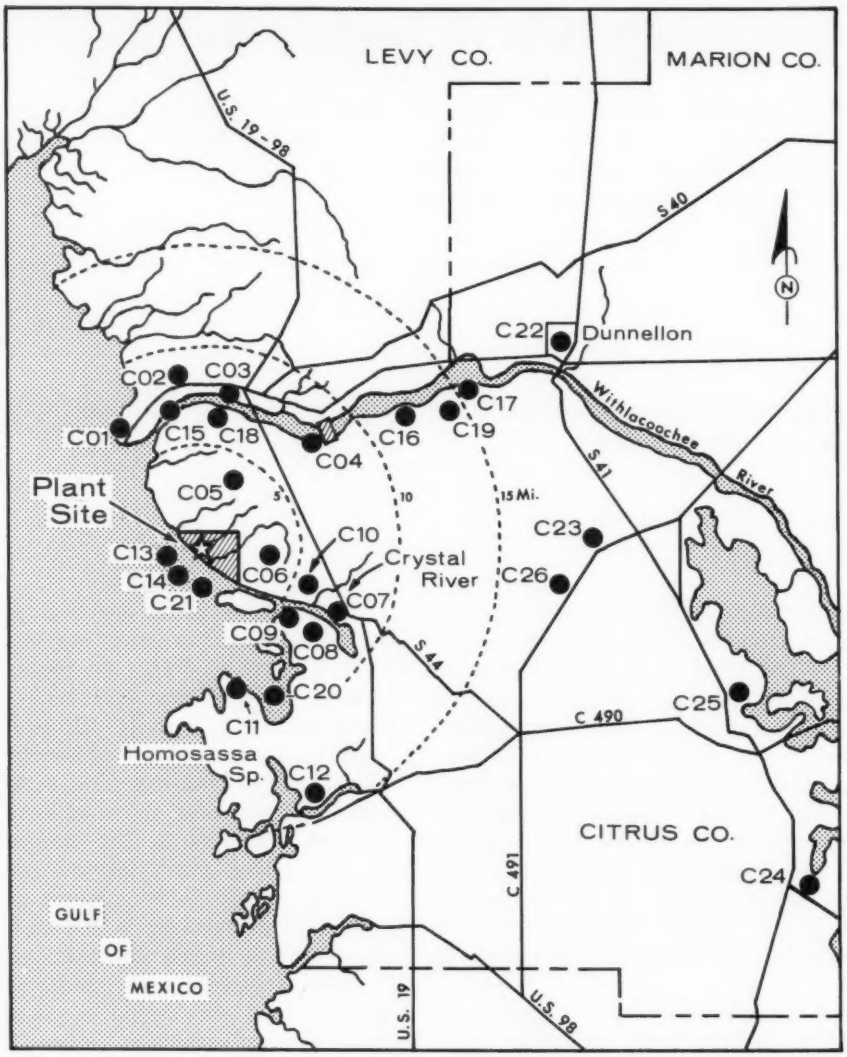

Figure 1. Radiological sampling sites—Crystal River

samples of soil and silt are presented in table 5.

Samples of drinking water were taken from wells at locations C 07, C 10, C 18, C 22, C 23 and C 24 during February, May, August and November. These samples were analyzed for gross beta, gross alpha, tritium, and gamma-emitting radionuclides. The only concentration of radioactivity above the minimum detectable activity found in any of these samples was 6 pCi/liter of gross beta radioactivity in a sample taken from location C 07 in August.

Samples of surface water were taken from locations C 15, C 16, and C 17 in February, May, August, and November and from location

Table 2. Concentration of radionuclides in vegetation samples, Crystal River, 1971

Radionuclide and sampling sites	Radionuclide concentration (pCi/kg wet weight)											
	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
Gross beta:												
C 01	3,860	4,380	4,680	6,200	6,750	5,640	5,280	6,140	5,320	5,500	4,600	4,500
C 02	NS	4,450	4,340	7,510	5,650	5,950	6,300	4,670	4,130	5,200	NS	6,300
C 03	3,380	6,390	4,150	7,720	4,920	6,630	6,130	6,460	5,000	5,300	4,300	4,500
C 04	5,440	4,080	5,330	5,480	6,540	5,620	6,850	5,350	4,350	6,500	5,600	3,900
C 05	2,650	5,430	4,070	5,420	4,320	4,800	6,350	5,280	4,050	5,500	6,700	4,300
C 06	4,410	4,820	4,630	7,530	9,220	6,730	7,460	5,490	4,950	4,700	4,100	4,500
C 08	5,630	6,060	3,700	6,520	5,660	6,510	5,450	6,020	4,850	5,800	5,700	4,800
C 09	4,980	5,300	5,340	8,070	6,560	8,050	7,620	5,830	4,970	7,300	6,500	5,800
C 11	4,480	5,320	4,800	3,350	7,630	8,150	9,300	8,020	7,840	6,700	5,400	3,800
C 12	5,080	6,250	5,680	7,000	6,260	7,130	6,770	4,940	6,310	5,500	5,800	4,400
Gross alpha:												
C 01	[a]	497	414	589	943	774	616	[a]	[a]	[a]	[a]	420
C 02	NS	597	722	1,090	964	793	887	[a]	[a]	[a]	NS	[a]
C 03	[a]	733	371	947	651	944	592	[a]	[a]	[a]	[a]	[a]
C 04	207	270	604	898	894	766	942	[a]	[a]	[a]	[a]	300
C 05	[a]	379	599	1,040	681	464	816	[a]	[a]	[a]	[a]	430
C 06	430	291	570	1,040	1,570	1,200	856	[a]	[a]	[a]	[a]	[a]
C 08	398	684	411	788	643	640	825	[a]	[a]	[a]	[a]	[a]
C 09	478	734	447	1,090	825	939	868	[a]	[a]	[a]	[a]	[a]
C 11	537	582	560	671	1,110	847	1,320	[a]	[a]	[a]	[a]	[a]
C 12	604	842	580	1,020	741	583	836	[a]	[a]	[a]	[a]	[a]
Cesium-137:												
C 01	180	80	120	490	210	340	230	380	190	140	230	210
C 02	NS	70	70	1,700	4,100	2,900	850	200	760	780	NS	630
C 03	510	210	200	330	260	730	310	260	280	250	310	270
C 04	3,000	2,000	620	440	730	670	840	1,000	790	930	900	1,500
C 05	1,500	1,000	2,000	2,100	1,200	1,300	2,000	1,900	2,100	1,500	2,900	2,300
C 06	220	470	330	320	8,000	5,300	590	540	490	540	410	360
C 08	100	[a]	70	150	90	140	130	80	80	NS	70	NS
C 09	80	[a]	70	90	80	200	110	[a]	[a]	140	100	130
C 11	160	150	120	1,200	100	120	5,100	210	[b]6,800	160	190	170
C 12	90	60	140	260	270	180	160	500	230	400	390	410
Potassium-40:												
C 01	3,900	3,700	4,200	3,800	4,600	3,700	4,200	4,800	5,400	5,300	4,000	3,400
C 02	NS	4,400	3,000	6,200	3,100	3,200	3,600	4,000	3,100	3,300	NS	4,900
C 03	2,300	6,400	3,500	8,300	4,900	2,300	5,400	6,600	5,500	5,500	4,600	4,300
C 04	3,300	1,800	3,800	3,200	5,700	2,900	4,500	4,700	4,200	6,300	5,300	2,400
C 05	1,500	4,800	2,100	2,200	2,500	2,800	4,600	5,400	1,900	5,200	6,600	2,100
C 06	4,900	3,300	2,900	4,900	2,700	1,800	4,900	2,700	3,600	2,600	2,300	3,700
C 08	6,200	6,300	3,300	6,500	5,700	6,000	4,600	6,700	4,900	6,500	6,100	4,700
C 09	5,700	5,200	5,800	7,200	6,500	4,000	6,000	6,100	5,700	6,400	6,200	6,600
C 11	3,700	4,700	4,100	1,100	6,800	5,600	4,600	6,000	4,100	5,200	4,500	4,000
C 12	5,700	6,900	5,800	5,200	4,900	5,900	6,000	5,400	6,700	5,900	6,600	3,800
Zirconium-95:												
C 01	100	300	220	750	940	720	680	840	180	80	190	170
C 02	[a]	240	430	0	560	680	1,200	610	430	320	[a]	200
C 03	140	130	160	300	280	900	150	330	110	70	70	50
C 04	210	310	340	840	520	700	510	750	320	[a]	80	170
C 05	250	240	280	749	580	560	470	480	580	100	170	230
C 06	90	310	340	970	960	960	690	1,200	760	470	320	110
C 08	80	140	200	400	240	310	420	300	300	130	100	[a]
C 09	80	160	230	860	420	810	540	410	250	380	50	[a]
C 11	200	340	280	740	860	610	700	1,500	850	550	450	90
C 12	70	150	200	820	660	360	180	460	380	200	90	80
Ruthenium-106:												
C 01	[a]	410	320	760	610	400	270	410	[a]	[a]	[a]	[a]
C 02	[a]	640	790	[a]	[a]	[a]	360	750	290	370		[a]
C 03	[a]	320	[a]	[a]	[a]	[a]	[a]	200	[a]	[a]	[a]	[a]
C 04	[a]	[a]	400	[c]560	[a]	340	[a]	480	570	[a]	[a]	[a]
C 05	[a]	[a]	[a]	630	[a]	[a]	[a]	[a]	[a]	[a]	[a]	[a]
C 06	[a]	[a]	430	[d]520	[a]	[a]	[a]	660	660	320	390	[a]
C 08	[a]	[a]	330	320	[a]	[a]	[a]	320	450	360	[a]	[a]
C 09	[a]	[a]	[a]	530	[a]	[a-e]	[a]	400	550	610	[a]	[a]
C 11	200	670	[a]	320	400	[a]	[a]	770	[a]	520	540	[a]
C 12	[a]	140	[a]	[f]650	350	[a]	[a]	[a]	420	[a]	[a]	[a]

[a] Less minimum detectable activity.
[b] This value lies outside the range of values expected for this sampling site.
[c] Cerium-144, 760 pCi/kg wet weight.
[d] Cerium-144, 880 pCi/kg wet weight.
[e] Cerium-144, 380 pCi/kg wet weight.
[f] Cerium-144, 640 pCi/kg wet weight.

Table 3. Radioactivity in selected types of vegetation Crystal River, 1971

Sampling sites and radionuclide	Palmetto berries (pCi/kg)	Saragassum (pCi/kg)	Saw palmetto (pCi/kg)	Orange (pCi/kg)
C 01:				
Gross beta	8,600			
Cesium-137	180			
Potassium-40	8,700			
C 01:				
Gross beta		5,800		
Gross alpha		3,400		
Potassium-40		6,100		
Zirconium-95		120		
C 02:				
Gross beta			3,400	
Cesium-137			200	
Potassium-40			2,600	
Zirconium-95			250	
C 19:				
February 1971:				
Gross beta				3,160
Gross alpha				533
Potassium-40				3,100
Strontium-90				190
November 1971:				
Gross beta				2,000
Gross alpha				210
Potassium-40				1,800
Strontium-90				85

C 12 in May and November. No concentrations of gross alpha, gross beta, tritium, or gamma-emitting radionuclides above the minimum detectable activities were found except for a value of 16 pCi/liter gross beta radioactivity in the November sample taken from location C 12.

No radioactivity was detected in the two samples of precipitation collected in November from locations C 07 and C 18.

Seawater was sampled at several locations around the Crystla River site. These samples were analyzed for gross alpha and beta radioactivity, tritium, and gamma-emitting radionuclides. The results of these analyses are presented in table 6.

In early March, a theromluminescent dosimeter network was established at five locations. The results of this network are presented in table 7.

Table 4. Radioactivity in marine biota, Crystal River, 1971

Vector and sampling site	Concentration (pCi/kg wet weight)															
	Gross beta				Gross alpha				Potassium-40				Cesium-137			
	Feb	May	Aug	Nov	Feb	May	Aug	Nov	Feb	May	Aug	Nov	Feb	May	Aug	Nov
Oysters:																
C 09	1,080				190				640							
C 12	500			900	60				ND			600				
C 14	1,710			1,900	ND				680			1,400				
C 20	1,160	1,490		930	108	109			920	1,100		750				
Blue crab:																
C 01	3,230				1,192				1,200							
C 08	2,550				931				1,200							
C 09		4,130				ND				2,200						
C 12	4,400	3,560	3,340		2,460	1,160	1,380		1,200	1,200	1,600				50	
C 21		2,800	3,203	2,300		1,137	978	1,600		1,700	1,700	1,300			ND	
Pin fish:																
C 21	1,420				ND				ND				890			
Mullet:																
C 08		3,070				800				2,000						
Hard tailjack:																
C 13		4,500				445				2,500						
Fish:																
C 01[a]				3,600				450				2,600				
C 08				4,000				1,100				2,500				
C 11				4,600				1,200				2,700				
C 13[b]				3,700				1,200				2,200				

[a] Strontium-90 concentrations for November 13 pCi/kg for Site C–01; 7 pCi/kg for C–08; 5 pCi/kg for C–11, and 9 pCi/kg for C–13.
[b] Site C–13 showed 21 pCi/kg of strontium-89.
ND, nondetectable.

Table 5. Radioactivity concentrations in soil and silt samples, Crystal River, 1971

Sampling site	Soil (pCi/kg)									
	Gross beta		Gross alpha		Cesium-137		Potassium-40	Cerium-144	Zirconium-95	Ruthenium-106
	Feb	Aug	Feb	Aug	Feb	Aug	Aug	Aug	Aug	Aug
C 01	[a]	[a]	6,580	[a]	[a]	50	[a]	830	160	190
C 02	[a]	[a]	[a]	[a]	[a]	180	[a]	710	180	230
C 03	[a]	[a]	[a]	[a]	60	1,200	410	900	180	290
C 04	[a]	[a]	[a]	[a]	530	1,300	[a]	580	100	[a]
C 05	[a]	10,700	[a]	9,180	530	1,100	[a]	1,400	310	520
C 06	[a]		[a]		220					
C 07	[a]	[a]		[a]		1,300	[a]	780	130	240
C 08	12,500	7,990	7,250	5,350	2,400	640	[a]	1,100	370	670
C 09	[a]	3,170	[a]	[a]	[a]	[a]	[a]	520	150	240
C 11	[a]	2,830	[a]	[a]	80	320	[a]	920	310	400
C 12	[a]	4,730	[a]	[a]	450	240	460	950	200	400

Sampling site	Silt[b] (pCi/kg)									
	Gross beta				Potassium-40[c]	Cerium-144				Zirconium-95[d]
	Feb	May	Aug	Nov	Aug	Feb	May	Aug	Nov	May
C 01	[a]	[a]	[a]	[a]	[a]	[a]	400	640	570	[a]
C 09	[a]	[a]	[a]	8,200	390	[a]	690	880	670	[a]
C 13	[a]	[a]	[a]	[a]	[a]	[a]	340	[a]	390	[a]
C 14	[a]	7,530	[a]	5,400	490	[a]	290	370	1,100	160

[a] Less minimum detectable activity.
[b] Gross beta radioactivity was less than the minimum detectable activity at all stations for all months.
[c] Potassium-40 was not detectable in samples taken during February, May or November.
[d] Zirconium-95 was not detected in samples taken during February, August or November.

Table 6. Radioactivity in seawater,[a] Crystal River, 1971

Location	Gross beta (pCi/liter)				Gross alpha (pCi/liter)	Potassium-40 (pCi/liter)			
	Feb	May	Aug	Nov	Feb	Feb	May	Aug	Nov
C 01	NS	NS	54	NS	NS	NS	NS	[b]	NS
C 08	88	51	20	74	4	[b]	[b]	[b]	[b]
C 09	36	108	146	130	7	[b]	[b]	[b]	[b]
C 11	175	287	90	200	16	[b]	[b]	[b]	[b]
C 12	14	NS	21	NS	3	[b]	[b]	[b]	[b]
C 13	244	329	390	340	[b]	280	220	260	280
C 14	377	284	314	330	[b]	210	220	[b]	200

[a] All concentrations of gross alpha radioactivity and gamma-emitting radionuclides were below minimum detectable activities except for those samples listed in the table.
[b] Less than the minimum detectable activity.
NS, no sample.

Table 7. Gross gamma radiation as measured by thermoluminescent dosimeters[a] Crystal River, 1971

Sampling location	Radiation dose rate (μrem/h) Date of removal (1971)								
	4/19	5/12	6/10	7/14	9/9	10/6	11/5	12/15	1/7/72
C 04	22	27	22	20	19	20	19	22	22
C 07	25	20	25	20	18	24	19	28	21
C 08	27	20	31	20	18	25	19	29	21
C 18	21	24	19	23	23	20	23	20	26
C 26	25	36	25	35	34	24	35	31	40
Mean	24	25	24	24	22	23	23	22	26

[a] The TLD's are of the CaF: Mn type. Since the data are being collected to determine any trends in the background rather than absolute measurements, the inherent background radiation of the TLD (due mostly to potassium-40 in the glass envelope was not subtracted from the readings in this table. The average inherent background radiation of these TLD's is 8 μrem/h.

Environmental Levels of Radioactivity at Atomic Energy Commission Installations

The U.S. Atomic Energy Commission (AEC) receives from its contractors semiannual reports on the environmental levels of radioactivity in the vicinity of major Commission installations. The reports include data from routine monitoring programs where operations are of such a nature that plant environmental surveys are required.

Releases of radioactive materials from AEC installations are governed by radiation standards set forth by AEC's Division of Operational Safety in directives published in the "AEC Manual."[1]

A summary of the environmental radioactivity data follow for the Brookhaven National Laboratory.

[1] Title 10, Code to Federal Regulations, Part 20, "Standards for Protection Against Radiation" contains essentially the standards published in Chapter 0524 of the AEC Manual.

1. Brookhaven National Laboratory[2] January–June 1970

Associated Universities, Inc.
Upton, N.Y.

The Brookhaven National Laboratory (BNL) operations may affect the environmental levels of radiation in three ways: (1) by radioactivity in the cooling air from the research reactors (2) by radiation from an ecology forest gamma-ray source, and (3) by low-level radioactive liquid wastes released to a stream that forms one of the headwaters of the Peconic River (figure 1). The radiation levels resulting from reactor air effluent and the ecology forest source are monitored continuously by four stations located at the site boundary. The liquid waste effluent from the laboratory sewage processing plant is monitored continuously at the point where the stream leaves the site.

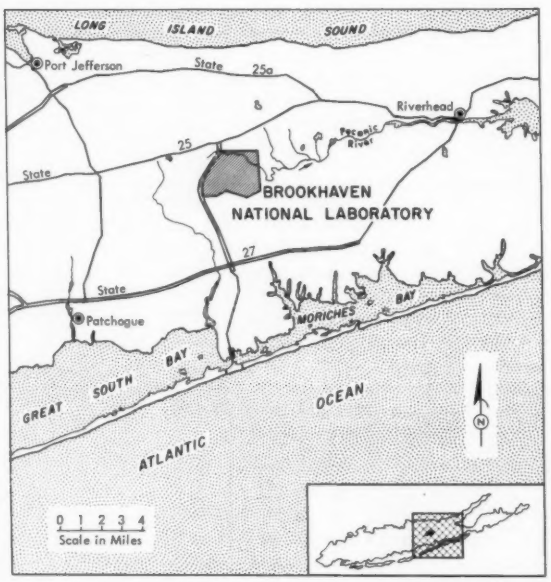

Figure 1. Brookhaven National Laboratory and surrounding area

Table 1. External gamma radioactivity at BNL site perimeter due to laboratory operations, January–June 1970

Date (1970)	Average exposure rates (mR/week)			
	Northwest perimeter	Southwest perimeter	Southeast perimeter	Northeast [a] perimeter
January	0.00	0.00	0.00	0.23
February	.00	.00	.00	.25
March	.00	.00	.00	.25
April	.00	.00	.00	.31
May	.00	.00	.00	.33
June	.00	.00	.00	.36
Highest weekly reading (January–June)	0.00	0.00	0.00	0.38
Average undisturbed background (January–June)	1.54	1.77	1.63	1.77

[a] Levels measured continuously at station on former perimeter, 2,630 feet north of source have been adjusted on the basis of periodic measurements at the present perimeter, 3,405 feet north.

[2] Summarized from "Effects of Brookhaven National Laboratory on Environmental Levels of Radioactivity during the First Half of 1970," Associated Universities Inc., Upton, N.Y. 11973.

Area monitoring

The average weekly radiation levels at the Brookhaven National Laboratory site perimeter (figure 2), due to laboratory operations, are given in table 1. Radiation levels at the northeast perimeter are somewhat greater than at other monitoring stations due to a cesium-137 source located in the nearby forest. The radiation levels at this location were only 2 percent of the established Atomic Energy Commission (AEC) radiation protection standard of 500 mrem/a for individuals in the general population. Values of radiation background levels undisturbed by laboratory operations also have been included in table 1 for purposes of comparison.

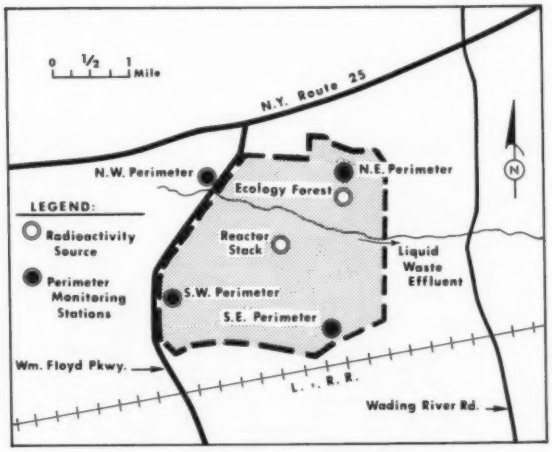

Figure 2. Brookhaven National Laboratory monitoring station locations

Water monitoring

The liquid waste effluent from the laboratory sewage processing plant is monitored continuously at the point where the stream leaves the BNL site. The average concentration and total amount of gross beta radioactivity in the liquid waste effluent, at the site boundary, are shown in table 2 for January–June 1970.

Analysis of composite samples of the effluent has shown that, on the average, less than 20 percent of the radioactivity consists of strontium-90. No appreciable amounts of radioactive iodine or bone-seeking radonuclides (such as radium) other than strontium, were present. Under these conditions, the applicable AEC radiation protection standard for discharge of liquid waste to uncontrolled areas would be 1 nCi/liter. The observed concentration in effluent was 1.5 percent of the standard.

Most gross beta measurement instruments are not sensitive to low energy beta emitters, such as tritium, for which special analytical methods must be employed. The concentration and amounts of tritium found during this reporting period in the laboratory's liquid waste effluent are also shown in table 2. The applicable AEC standard is 3 μCi/liter, averaged over a period of 1 year. The observed concentration of tritium at BNL was 0.8 percent of this standard.

Recent coverage in *Radiation Data and Reports:*

Period	Issue
July–December 1969	September 1972

Table 2. Gross beta radioactivity in liquid waste effluent at BNL site boundary January–June 1970

1970 (Date)	Volume of flow (gallons/day)	Average beta radioactivity concentration (pCi/liter)	Total beta radioactivity concentration discharged (mCi)	Tritium concentration (nCi/liter)	Tritium radioactivity (Ci)
January	978,000	12	1.2	8	0.8
February	857,000	11	1.0	12	1.1
March	660,000	15	1.3	75	6.4
April	1,460,000	13	1.9	10	1.6
May	1,180,000	16	2.5	22	3.5
June	1,157,000	25	3.1	30	3.7
Summary January–June	1,130,000	15	11.0	28	16.6

Nuclear Power Reactors in the United States
September 30, 1972

Each quarter year, the Atomic Energy Commission releases information on the status of all present and proposed civilian nuclear power generating units in the United States. This information is reproduced for interested readers of *Radiation Data and Reports.*

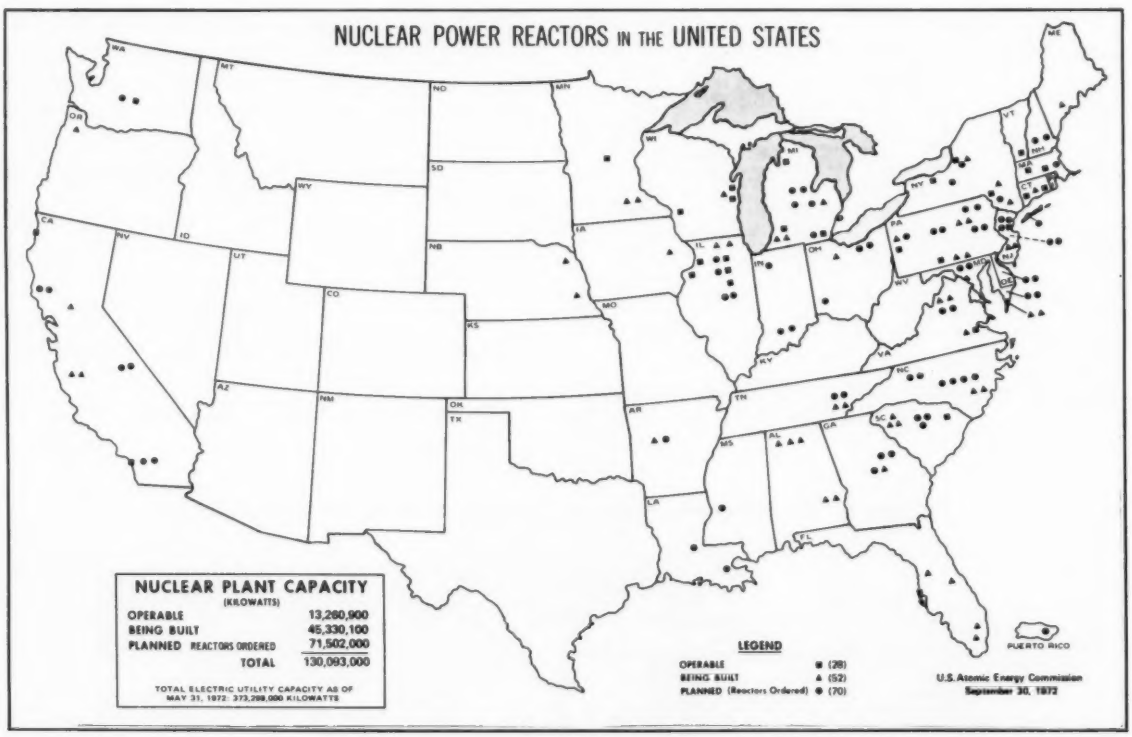

Figure 1. Nuclear power plants in the United States

SITE	PLANT NAME	CAPACITY (Net Kilowatts)	UTILITY	INITIAL DESIGN POWER
ALABAMA				
Decatur	Browns Ferry Nuclear Power Plant: Unit 1	1,065,000	Tennessee Valley Authority	1973
Decatur	Browns Ferry Nuclear Power Plant: Unit 2	1,065,000	Tennessee Valley Authority	1973
Decatur	Browns Ferry Nuclear Power Plant: Unit 3	1,065,000	Tennessee Valley Authority	1974
Dothan	Joseph M. Farley Nuclear Plant: Unit 1	829,000	Alabama Power Co.	1975
Dothan	Joseph M. Farley Nuclear Plant: Unit 2	829,000	Alabama Power Co.	1977
ARKANSAS				
Russellville	Arkansas Nuclear One: Unit 1	820,000	Arkansas Power & Light Co.	1973
Russellville	Arkansas Nuclear One: Unit 2	920,000	Arkansas Power & Light Co.	1975
CALIFORNIA				
Humboldt Bay	Humboldt Bay Power Plant: Unit 3	68,500	Pacific Gas and Electric Co.	1963
San Clemente	San Onofre Nuclear Generating Station: Unit 1	430,000	So. Calif. Ed. & San Diego Gas & El. Co.	1967
San Clemente	San Onofre Nuclear Generating Station: Unit 2	1,140,000	So. Calif. Ed. & San Diego Gas & El. Co.	–
San Clemente	San Onofre Nuclear Generating Station: Unit 3	1,140,000	So. Calif. Ed. & San Diego Gas & El. Co.	–
Diablo Canyon	Diablo Canyon Nuclear Power Plant: Unit 1	1,060,000	Pacific Gas and Electric Co.	1974
Diablo Canyon	Diablo Canyon Nuclear Power Plant: Unit 2	1,060,000	Pacific Gas and Electric Co.	1975
Clay Station	Rancho Seco Nuclear Generating Station	804,000	Sacramento Municipal Utility District	1973
Pt. Arena	Mendocino Power Plant: Unit 1	1,128,000	Pacific Gas & Electric Co.	1979
Pt. Arena	Mendocino Power Plant: Unit 2	1,128,000	Pacific Gas & Electric Co.	1979
*	–	770,000	Southern California Edison Co.	1981
*	–	770,000	Southern California Edison Co.	1982
COLORADO				
Platteville	Ft. St. Vrain Nuclear Generating Station	330,000	Public Service Co. of Colorado	1973
CONNECTICUT				
Haddam Neck	Haddam Neck Plant	575,000	Conn. Yankee Atomic Power Co.	1967
Waterford	Millstone Nuclear Power Station: Unit 1	652,100	Northeast Utilities	1970
Waterford	Millstone Nuclear Power Station: Unit 2	828,000	Northeast Utilities	1974
DELAWARE				
*	Delmarva Unit 1	770,000	Delmarva Power & Light Co.	1978
*	Delmarva Unit 2	770,000	Delmarva Power & Light Co.	1982
FLORIDA				
Turkey Point	Turkey Point Station: Unit 3	693,000	Florida Power & Light Co.	1972
Turkey Point	Turkey Point Station: Unit 4	693,000	Florida Power & Light Co.	1973
Red Level	Crystal River Plant: Unit 3	825,000	Florida Power Corp.	1973
Ft. Pierce	Hutchinson Island: Unit 1	800,000	Florida Power and Light Co.	1975
GEORGIA				
Baxley	Edwin I. Hatch Nuclear Plant: Unit 1	786,000	Georgia Power Co.	1973
Baxley	Edwin I. Hatch Nuclear Plant: Unit 2	786,000	Georgia Power Co.	1976
Waynesboro	Alvin W. Vogtle, Jr. Plant: Unit 1	1,105,000	Georgia Power Co.	1978
Waynesboro	Alvin W. Vogtle, Jr. Plant: Unit 2	1,105,000	Georgia Power Co.	1979
ILLINOIS				
Morris	Dresden Nuclear Power Station: Unit 1	200,000	Commonwealth Edison Co.	1960
Morris	Dresden Nuclear Power Station: Unit 2	800,000	Commonwealth Edison Co.	1970
Morris	Dresden Nuclear Power Station: Unit 3	900,000	Commonwealth Edison Co.	1972
Zion	Zion Nuclear Plant: Unit 1	1,050,000	Commonwealth Edison Co.	1972
Zion	Zion Nuclear Plant: Unit 2	1,050,000	Commonwealth Edison Co.	1973
Cordova	Quad-Cities Station: Unit 1	800,000	Comm. Ed. Co.-Ia.-Ill. Gas & Elec. Co.	1972
Cordova	Quad-Cities Station: Unit 2	800,000	Comm. Ed. Co.-Ia.-Ill. Gas & Elec. Co.	1972
Seneca	LaSalle Co. Nuclear Station: Unit 1	1,078,000	Comm. Ed. Co.-Ia.	1977
Seneca	LaSalle Co. Nuclear Station: Unit 2	1,078,000	Comm. Ed. Co.-Ia.	1978
*	Comed West: Unit 1	1,100,000	Comm. Edison Co.	1978
*	Comed West: Unit 2	1,100,000	Comm. Edison Co.	1979
*	Comed West: Unit 3	1,100,000		1980
*	Comed West: Unit 4	1,100,000		1981
INDIANA				
Dune Acres	Bailly Generating Station	660,000	Northern Indiana Public Service Co.	1977
IOWA				
Palo	Duane Arnold Energy Center: Unit 1	529,700	Iowa Electric Light and Power Co.	1973
LOUISIANA				
Taft	Waterford Generating Station	1,165,000	Louisiana Power & Light Co.	1976
St. Francisville	River Bend Station	940,000	Gulf States Utilities Co.	1979
MAINE				
Wiscasset	Maine Yankee Atomic Power Plant	790,000	Maine Yankee Atomic Power Co.	1972

Figure 1. Nuclear power plants in the United States—continued

SITE	PLANT NAME	CAPACITY (Net Kilowatts)	UTILITY	INITIAL DESIGN POWER
MARYLAND				
Lusby	Calvert Cliffs Nuclear Power Plant: Unit 1	845,000	Baltimore Gas and Electric Co.	1973
Lusby	Calvert Cliffs Nuclear Power Plant: Unit 2	845,000	Baltimore Gas and Electric Co.	1974
Perryman	Perryman Nuclear Plant: Unit 1	845,000	Baltimore Gas and Electric Co.	1979
Perryman	Perryman Nuclear Plant: Unit 2	845,000	Baltimore Gas and Electric Co.	1980
Douglas Point	Douglas Point Project: Unit 1	1,100,000	Potomac Electric Power Co.	1980
Douglas Point	Douglas Point Project: Unit 2	1,100,000	Potomac Electric Power Co.	1981
MASSACHUSETTS				
Rowe	Yankee Nuclear Power Station	175,000	Yankee Atomic Electric Co.	1961
Plymouth	Pilgrim Station: Unit 1	655,000	Boston Edison Co.	1972
Plymouth	Pilgrim Station: Unit 2	1,180,000	Boston Edison Co.	1978
MICHIGAN				
Big Rock Point	Big Rock Point Nuclear Plant	70,300	Consumers Power Co.	1963
South Haven	Palisades Nuclear Power Station	700,000	Consumers Power Co.	1971
Lagoona Beach	Enrico Fermi Atomic Power Plant: Unit 1	60,900	Detroit Edison Co.	1970
Lagoona Beach	Enrico Fermi Atomic Power Plant: Unit 2	1,123,000	Detroit Edison Co.	1976
Lagoona Beach	Enrico Fermi Atomic Power Plant: Unit 3	1,124,000	Detroit Edison Co.	1980
Bridgman	Donald C. Cook Plant: Unit 1	1,060,000	Indiana & Michigan Electric Co.	1973
Bridgman	Donald C. Cook Plant: Unit 2	1,060,000	Indiana & Michigan Electric Co.	1974
Midland	Midland Nuclear Power Plant: Unit 1	492,000	Consumers Power Co.	1977
Midland	Midland Nuclear Power Plant: Unit 2	818,000	Consumers Power Co.	1978
St. Clair County	Greenwood: Unit 2	1,240,000	Detroit Edison Co.	1979
St. Clair County	Greenwood: Unit 3	1,240,000	Detroit Edison Co.	1981
MINNESOTA				
Monticello	Monticello Nuclear Generating Plant	545,000	Northern States Power Co.	1971
Red Wing	Prairie Island Nuclear Generating Plant: Unit 1	530,000	Northern States Power Co.	1972
Red Wing	Prairie Island Nuclear Generating Plant: Unit 2	530,000	Northern States Power Co.	1974
MISSISSIPPI				
Port Gibson	Grand Gulf Nuclear Station	1,275,000	Mississippi Power & Light Co.	1978
NEBRASKA				
Fort Calhoun	Ft. Calhoun Station: Unit 1	457,400	Omaha Public Power District	1973
Brownville	Cooper Nuclear Station	778,000	Nebraska Public Power District and Iowa Power and Light Co.	1973
NEW HAMPSHIRE				
Seabrook	–	1,100,000	Public Service of N.H.	1979
Seabrook	–	1,100,000	Public Service of N.H.	1981
NEW JERSEY				
Toms River	Oyster Creek Nuclear Power Plant: Unit 1	640,000	Jersey Central Power & Light Co.	1969
Forked River	Forked River Generating Station: Unit 1	1,070,000	Jersey Central Power & Light Co.	1978
Salem	Salem Nuclear Generating Station: Unit 1	1,090,000	Public Service Electric and Gas, N.J.	1974
Salem	Salem Nuclear Generating Station: Unit 2	1,115,000	Public Service Electric and Gas, N.J.	1975
Bordentown	Newbold Nuclear Generating Station: Unit 1	1,067,000	Public Service Electric and Gas, N.J.	1978
Bordentown	Newbold Nuclear Generating Station: Unit 2	1,067,000	Public Service Electric and Gas, N.J.	1979
Offshore	Atlantic Generating Station: Unit 1	1,150,000	Public Service Electric and Gas, N.J.	1980
Offshore	Atlantic Generating Station: Unit 2	1,150,000	Public Service Electric and Gas, N.J.	1981
NEW YORK				
Indian Point	Indian Point Station: Unit 1	265,000	Consolidated Edison Co.	1963
Indian Point	Indian Point Station: Unit 2	873,000	Consolidated Edison Co.	1972
Indian Point	Indian Point Station: Unit 3	965,000	Consolidated Edison Co.	1974
Scriba	Nine Mile Point Nuclear Station: Unit 1	625,000	Niagara Mohawk Power Co.	1970
Scriba	Nine Mile Point Nuclear Station: Unit 2	1,080,000	Niagara Mohawk Power Co.	1978
Ontario	R.E.Ginna Nuclear Power Plant: Unit 1	420,000	Rochester Gas & Electric Co.	1970
Brookhaven	Shoreham Nuclear Power Station	819,000	Long Island Lighting Co.	1977
Lansing	Bell Station	838,000	New York State Electric & Gas. Co.	1978
Verplanck	Con. Ed. Nuclear =4	1,115,000	Consolidated Edison Co.	1977
Scriba	James A. Fitzpatrick Nuclear Power Plant	821,000	Power Authority of State of N.Y.	1973
NORTH CAROLINA				
Southport	Brunswick Steam Electric Plant: Unit 1	821,000	Carolina Power and Light Co.	1975
Southport	Brunswick Steam Electric Plant: Unit 2	821,000	Carolina Power and Light Co.	1974
Cowans Ford Dam	Wm. B. McGuire Nuclear Station: Unit 1	1,180,000	Duke Power Co.	1975
Cowans Ford Dam	Wm. B. McGuire Nuclear Station: Unit 2	1,180,000	Duke Power Co.	1977
Bonsal	Shearon Harris Plant: Unit 1	915,000	Carolina Power & Light Co.	1977
Bonsal	Shearon Harris Plant: Unit 2	915,000	Carolina Power & Light Co.	1978
Bonsal	Shearon Harris Plant: Unit 3	915,000	Carolina Power & Light Co.	1979
Bonsal	Shearon Harris Plant: Unit 4	915,000	Carolina Power & Light Co.	1980

Figure 1. Nuclear power plants in the United States—continued

SITE	PLANT NAME	CAPACITY (Net Kilowatts)	UTILITY	INITIAL DESIGN POWER
OHIO				
Oak Harbor	Davis-Besse Nuclear Power Station	872,000	Toledo Edison-Cleveland Electric Illuminating Co.	1974
Painesville	Perry Nuclear Power Plant: Unit 1	1,100,000	Cleveland Electric Illuminating Co.	1979
Painesville	Perry Nuclear Power Plant: Unit 2	1,100,000	Cleveland Electric Illuminating Co.	1980
Moscow	Wm. H. Zimmer Nuclear Power Station: Unit 1	810,000	Cincinnati Gas & Electric Co.	1976
OREGON				
Prescott	Trojan Nuclear Plant: Unit 1	1,130,000	Portland General Electric Co.	1974
PENNSYLVANIA				
Peach Bottom	Peach Bottom Atomic Power Station: Unit 1	40,000	Philadelphia Electric Co.	1967
Peach Bottom	Peach Bottom Atomic Power Station: Unit 2	1,065,000	Philadelphia Electric Co.	1973
Peach Bottom	Peach Bottom Atomic Power Station: Unit 3	1,065,000	Philadelphia Electric Co.	1974
Pottstown	Limerick Generating Station: Unit 1	1,065,000	Philadelphia Electric Co.	1976
Pottstown	Limerick Generating Station: Unit 2	1,065,000	Philadelphia Electric Co.	1977
Shippingport	Shippingport Atomic Power Station: Unit 1	90,000	Duquesne Light Co.	1957
Shippingport	Beaver Valley Power Station: Unit 1	856,000	Duquesne Light Co.-Ohio Edison Co.	1974
Shippingport	Beaver Valley Power Station: Unit 2	856,000	Duquesne Light Co.-Ohio Edison Co.	1978
Goldsboro	Three Mile Island Nuclear Station: Unit 1	819,000	Metropolitan Edison Co.	1973
Goldsboro	Three Mile Island Nuclear Station: Unit 2	905,000	Jersey Central Power & Light Co.	1975
Berwick	Susquehanna Steam Electric Station: Unit 1	1,052,000	Pennsylvania Power and Light	1979
Berwick	Susquehanna Steam Electric Station: Unit 2	1,052,000	Pennsylvania Power and Light	1981
*	Philadelphia Electric Co.: HTGR No. 1	1,140,000	Philadelphia Electric Co.	1979
*	Philadelphia Electric Co.: HTGR No. 2	1,140,000	Philadelphia Electric Co.	1981
SOUTH CAROLINA				
Hartsville	H. B. Robinson S.E. Plant: Unit 2	700,000	Carolina Power & Light Co.	1971
Seneca	Oconee Nuclear Station: Unit 1	841,000	Duke Power Co.	1972
Seneca	Oconee Nuclear Station: Unit 2	886,000	Duke Power Co.	1973
Seneca	Oconee Nuclear Station: Unit 3	886,000	Duke Power Co.	1973
Broad River	Virgil C. Summer Nuclear Station: Unit 1	900,000	South Carolina Electric & Gas Co.	1977
York County	Catawba Nuclear Station: Unit 1	1,180,000	Duke Power Co.	1979
York County	Catawba Nuclear Station: Unit 2	1,180,000	Duke Power Co.	1980
TENNESSEE				
Daisy	Sequoyah Nuclear Power Plant: Unit 1	1,140,000	Tennessee Valley Authority	1974
Daisy	Sequoyah Nuclear Power Plant: Unit 2	1,140,000	Tennessee Valley Authority	1975
Spring City	Watts Bar Nuclear Plant: Unit 1	1,169,000	Tennessee Valley Authority	1977
Spring City	Watts Bar Nuclear Plant: Unit 2	1,169,000	Tennessee Valley Authority	1978
VERMONT				
Vernon	Vermont Yankee Generating Station	513,900	Vermont Yankee Nuclear Power Corp.	1972
VIRGINIA				
Gravel Neck	Surry Power Station: Unit 1	788,000	Virginia Electric & Power Co.	1972
Gravel Neck	Surry Power Station: Unit 2	788,000	Virginia Electric & Power Co.	1973
Mineral	North Anna Power Station: Unit 1	845,000	Virginia Electric & Power Co.	1974
Mineral	North Anna Power Station: Unit 2	845,000	Virginia Electric & Power Co.	1975
Mineral	North Anna Power Station: Unit 3	900,000	Virginia Electric & Power Co.	1977
Mineral	North Anna Power Station: Unit 4	900,000	Virginia Electric & Power Co.	1978
WASHINGTON				
Richland	N-Reactor/WPPSS Steam	800,000	Atomic Energy Commission	1966
Richland	Hanford No. 2	1,103,000	Washington Public Power Supply System	1977
WISCONSIN				
Genoa	Genoa Nuclear Generating Station	53,200	Dairyland Power Cooperative	1969
Two Creeks	Point Beach Nuclear Plant: Unit 1	497,000	Wisconsin Michigan Power Co.	1971
Two Creeks	Point Beach Nuclear Plant: Unit 2	497,000	Wisconsin Michigan Power Co.	1972
Carlton	Kewaunee Nuclear Power Plant: Unit 1	541,000	Wisconsin Michigan Power Co.	1972
PUERTO RICO				
Puerto De Jobas	Aguirre Nuclear Power Plant	583,000	Puerto Rico Water Resources Authority	1975
*	–	1,175,000	Tennessee Valley Authority	1977
*	–	1,175,000	Tennessee Valley Authority	1978

* Site not selected.

Figure 1. Nuclear power plants in the United States—continued

Reported Nuclear Detonations, November 1972

(Includes seismic signals presumably from foreign nuclear detonations)

No nuclear detonations by the United States were reported by the U.S. Atomic Energy Commission for December 1972.

The U.S. Atomic Energy Commission announced that the United States had recorded seismic signals, presumably from a Soviet underground nuclear explosion on November 1, 1972. The signals originated from the Semipalatinsk nuclear test area and were equivalent to those of an underground nuclear explosion in the yield range of 200 kilotons to 1 megaton.

Seismic signals, presumably from a Soviet underground nuclear explosion, were recorded by the United States on November 24, 1972. The signals originated at approximately 5:00 a.m. (EST) November 24, 1972, in the southeastern Ural area of the USSR, and were equivalent to those of an underground nuclear explosion in the yield range of 20-200 kilotons.

Information in this section is based on data received during the month, and is subject to change as additional information may become available. Persons requiring information for purposes of compiling announced nuclear detonation statistics are advised to contact the Division of Public Information, U.S. Atomic Energy Commission, Washington, D.C. 20545.

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USE OF A FALLOUT CESIUM-137 AS A TRACER TO DEFINE THE RECENT DELTAIC FACIES OF A RIVER. *P. Plato and G. C. Goldman. Radiation Data and Reports, Vol. 13, December 1972, pp. 653-657.*

Using fallout cesium-137 as a tracer, the size and location of the deltaic facies in Lake Michigan of the St. Joseph River are described. Approximately 185 sediment samples were collected and analyzed for cesium-137 aboard ship during five working days. Contour lines are shown that reprsent the measured concentrations of cesium-137 in the deltaic facies produced by the St. Joseph River.

KEYWORDS: Cesium-137, deltaic facies, fallout, Lake Michigan, river-lake interface, sediment, St. Joseph River.

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